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Soil Survey

Brown County Indiana

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with a section on Management of the Soils of Brown County
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UNITED STATES DEPARTMENT OF AGRICULTURE
Bureau of Plant Industry, Soils, and Agricultural Engineering
Agricultural Research Administration
In cooperation with the
Purdue University Agricultural Experiment Station

HOW TO USE THE SOIL SURVEY REPORT

SOIL SURVEYS provide a foundation for all land use programs. This report and the accompanying map present information both general and specific about the soils, the crops, and the agriculture of the area surveyed. The individual reader may be interested in the whole report or only in some particular part. Ordinarily he will be able to obtain the information he needs without reading the whole. Prepared for both general and detailed use, the report is designed to meet the needs of a wide variety of readers of three general groups: (1) Those interested in the area as a whole; (2) farmers and others interested in specific parts of it; and (3) students and teachers of soil science and related agricultural subjects. Attempt has been made to meet the needs of all three groups by making the report comprehensive for purposes of reference.

Readers interested in the area as a whole include those concerned with general land use planning—the placement and development of highways, power lines, urban sites, industries, community cooperatives, resettlement projects, and areas for forest and wildlife management and for recreation. The following sections are intended for such users: (1) County Surveyed, in which physiography, vegetation, water supply, population, and cultural developments are discussed; (2) Agricultural History and Statistics, in which a brief history and the present status of the agriculture are described; (3) Productivity Ratings, in which are presented the productivity of the soils; and (4) Management of the Soils of Brown County, in which their management requirements are discussed, and suggestions made for improvement.

Readers interested chiefly in specific areas—as some particular locality, farm, or field—include farmers, agricultural technicians interested in planning operations in communities or on individual farms, and real estate agents, land appraisers, prospective purchasers and tenants, and farm loan agencies. These readers should (1) locate on the map the tract with which concerned; (2) identify the soils on the tract by locating in the legend on the margin of the map the symbols and colors that represent them; and (3) locate in the table of contents in the section on Soils and Crops the page where each type is described in detail and information given as to its suitability for use and its relations to crops and agriculture. They will also find useful specific information relating to the soils in the sections on Productivity Ratings and on Management of the Soils of Brown County.

Students and teachers of soil science and allied subjects—including crop production, forestry, animal husbandry, economics, rural sociology, geography, and geology—will find their special interest in the section on Morphology and Genesis of Soils. They will also find useful information in the section on Soils and Crops, in which are presented the general scheme of classification of the soils of the area and a detailed discussion of each type. For those not already familiar with the classification and mapping of soils, these subjects are discussed under Soil Survey Methods and Definitions. Teachers of other subjects will find the sections on County Surveyed, Agricultural History and Statistics, Productivity Ratings, and the first part of the section on Soils and Crops of particular value in determining the relations between their special subjects and the soils in the county. Soil scientists and students of soils will find special interest in the section on Morphology and Genesis of Soils.

This publication on the soil survey of Brown County, Ind., is a cooperative contribution from the—

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SOIL SURVEY OF BROWN COUNTY, INDIANA

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CONTENTS

BROWN COUNTY, lying in the Interior Plains physical division, is a part of the Norman Upland, which consists of long, narrow ridges, fairly steep slopes, and narrow stream bottoms. Most of the early settlers came from Kentucky and the Carolinas, but a few from Pennsylvania. Originally a forest growth of the oak-hickory association covered the entire county, but now most of the stream bottoms and broader ridge tops have been cleared and are cultivated. The present stands consist of second-growth trees of the original forest. Corn, wheat, oats, soybeans, and hay are the principal crops, but plantings of alfalfa and lespedeza are increasing. A small acreage is used for rye, sorgo, and millet. Tomatoes are grown on contract for canning factories, and some tobacco is produced. Part of the farm produce is marketed, but most of the livestock raised is for home consumption. Sawmills convert logs into railroad cross ties and rough lumber for local use. To provide a basis for the best agricultural uses of the land a cooperative soil survey was begun in 1936 by the United States Department of Agriculture and the Purdue University Agricultural Experiment Station. The essential features may be summarized as follows:

[1] The field work for this survey was done while the Division was a part of the Bureau of Chemistry and Soils.

SUMMARY

Brown County is in the south-central part of Indiana. It is rectangular in shape, and its total area is 324 square miles.

The surface features are those of a severely dissected former plain with long, narrow ridges, steep slopes, and comparatively narrow valleys. The general slope of the land is from northeast to southwest, and the average elevation is slightly over 900 feet above sea level.

The native vegetation belongs to the oak-hickory association, and originally a heavy forest growth covered the entire county.

The county was organized in February 1836. The 1940 census reports a population of 6,189.

One railroad and three hard-surfaced State highways serve the county, and some of the county roads are graveled.

The climate is humid, temperate, and continental. The rainfall is well distributed throughout the year, and there is an annual precipitation of 40.98 inches.

Farming began in 1820, when the first white settlers came to the county. At present agriculture consists of the growing of corn, wheat, oats, soybeans, and hay and the raising of livestock. The average size of farms in 1940 was 108.3 acres.

Altogether 24 soil types, 10 phases, and 1 complex are mapped in the county. With one exception, all the soils are light-colored and are acid in reaction.

The soils formed from residual materials are all well drained and are low in organic matter. Included in this group are the Zanesville, Tilsit, Wellston, and Muskingum soils.

Soils formed from glacial till have a wide range in drainage. Of those developed from Illinoian till, Parke silt loam has rapid drainage, and the Cincinnati, Gibson, Avonburg, and Clermont soils have progressively less rapid and poorer natural drainage. Soils developed from early Wisconsin till include silt loams of the well-drained Russell and the imperfectly drained Fincastle series.

Of the soils developed from stream-terrace deposits, those formed from glacial-fluvial materials are represented by Otwell and Haubstadt soils, both of which are well drained; and those formed from deposits of mixed origin include Elkinsville, Pekin, Bartle, and Peoga soils.

The alluvial soils include members of the Pope, Philo, Stendal, and Atkins series.

Estimates of yields and productivity ratings show the relation among the soils of the county in terms of relative productivity for the important crops.

The soils belong to the Gray-Brown Podzolic great soil group. The outstanding factors of environment influencing soil development are a rainfall heavy enough to wet the soil to an indefinite depth so that a moist condition is maintained throughout the soil and into the parent material; a temperate climate; and a deciduous forest cover under which the soils have developed.

COUNTY SURVEYED

Brown County is in the south-central part of Indiana (fig. 1). Nashville, the county seat, is about 40 miles south of Indianapolis, the State capital. The county is rectangular in shape and comprises 324 square miles, or 207,360 acres.

Brown County lies in the Interior Plains physical division of the United States; and more specifically, it is a part of the Norman

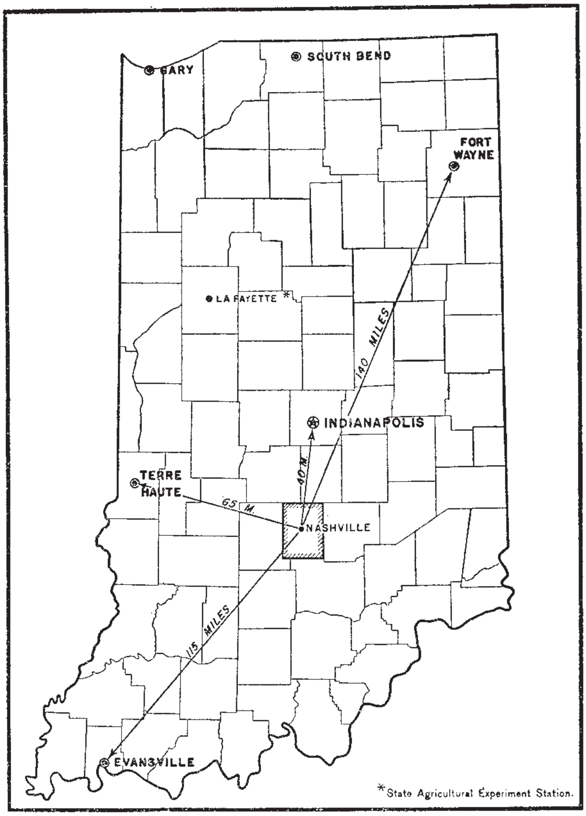

FIGURE 1.—Location of Brown County in Indiana.

Upland.[2] This is a severely dissected former plain, consisting of long, narrow ridges, rather steep slopes, and narrow stream bottoms. Generally speaking, three more or less parallel main ridges traverse the county in a northeast-southwest direction. Short spur ridges project from these main ridges in a dendritic fashion. Three streams flow roughly parallel to the main ridges, in a west-southwest direction, and their tributaries have cut narrow V-shaped valleys into the uplands. The south-flowing tributaries are three to four times as long as those flowing north, and in several places the drainage divide is a narrow ridge a few rods south of the main stream.

[2] LOGAN, W. N., CUMINGS, E. R., MALOTT, C. A., VISHER, S. S., TUCKER, W. M., and REEVES, J. R. HANDBOOK OF INDIANA GEOLOGY. Ind. Dept. Conserv. Pub. 21, 1120 pp., illus. 1922.

The Illinoian glaciation advanced upon the county as far south as Bean Blossom Creek,[3] where it was checked by the northernmost of the three main parallel ridges. In some places the glacial drift is several feet in depth, but in most places it is a thin veneer over the sandstone and shale bedrock. In many places within the glaciated area the glacier left little evidence of its passing.

The action of the glacier modified the area covered, broadening the ridges, lessening the steepness of the slopes, and widening the valleys. The glacier crossed the main ridge south of Bean Blossom Creek in several places; and some glacial till may be seen along the larger streams and their tributaries, generally in isolated areas well up the slopes. Small isolated areas of glacial till also occur in the central and eastern parts of the county as far south as the Brown-Jackson County line.

A later stage of glaciation, the early Wisconsin, just touched the extreme northeastern part of the county, where less than 1 square mile was covered by its deposits.

Fairly wide first bottoms, or alluvial lands, border the three main permanent streams in the county—Bean Blossom Creek in the northern part, North Fork Salt Creek in the central part, and Middle Fork Salt Creek in the southern part. During periods of excessive rainfall the first bottoms are subject to overflow, but floodwaters remain for only a few days, except in the low places situated well back from the main streams. Here, water covers the land for several days after it has receded from higher areas adjacent to the streams.

The second bottoms, or terraces, are extensive along the wider valleys. They occur at a varying height above the stream bed, a few lying 30 feet or more above the valley floor.

In general, the land slopes from the northeast to the southwest. The highest elevation of the county—1,058 feet[4] above sea level—is at Weed Patch Hill, about 5 miles southeast of Nashville; and the lowest elevations are in the deeper stream valleys in the southwestern part of the county. The average elevation is slightly over 900 feet.[5]

Originally a forest growth of the oak-hickory association covered the entire county, but at present most of the stream bottoms and broader ridge tops have been cleared and put into cultivation. The original tree growth included shellbark hickory, black, red, white, and chestnut oaks, black ash and white ash, black walnut, red maple, silver maple (locally called soft maple), hard maple, tuliptree (tulip poplar), elm, sycamore, and sassafras. Shrubs and vines include papaw, sumac, blackberry, and wild grape.

The present tree growth consists of second-growth trees of the original forest. Practically all of the virgin timber has been cut, and at present trees are allowed to grow only large enough to be used for cross ties (12 to 14 inches in diameter) before being cut.

The chief sources of water in Brown County are shallow wells, springs, and the larger permanent streams. No great difficulty is experienced in obtaining water in the valleys and in areas where the glacial till is thick, but in the uplands underlain by sandstone an

[3] See footnote 2, p. 3.
[4] U. S. Geological Survey bench mark.
[5] See footnote 2, p. 3.

adequate supply of water is very difficult to obtain. Here, rain water is collected in cisterns to supplement the water obtained from wells. Water from deep wells driven into the bedrock generally is salty or has a disagreeable taste.

According to local information the first settlements in what is now Brown County were made along Schooner Creek and near the present site of Elkinsville, about 1820. Most of the early settlers came from Kentucky and the Carolinas and gradually worked their way up from the Ohio River, but a few of German descent migrated from Pennsylvania.

Brown County was created from Monroe, Jackson, and Bartholomew Counties in February 1836. The 1940 census reports a population of 6,189.

Nashville, in the central part of the county, always has been the county seat. In 1940 it had a population of 493. Helmsburg and Trevlac, small towns on the Illinois Central Railroad, are shipping centers for the county. A large sawmill at Trevlac converts logs into railroad cross ties and rough lumber for local use.

The Illinois Central, the only railroad serving the county, crosses the northwestern corner. A State highway traverses the county from north to south, passing through Bean Blossom, Nashville, and Story; another traverses it from east to west, passing through Nashville and Belmont; and a third runs in a general westerly direction from Bean Blossom through Helmsburg, Trevlac, and Needmore. All these highways are hard-surfaced. They are the principal routes of commerce into and out of the county. Some of the county roads are graveled, but many are not well maintained and become impassable in the winter and in periods of extremely wet weather.

Practically all of the farm produce is hauled to market in trucks; shipments on the railroad generally consist only of cross ties. Most of the livestock raised is for consumption in the home, and the small surplus is shipped by motortruck to markets in Indianapolis and in Cincinnati and Columbus, Ohio. Tomatoes are shipped by motortruck to canning factories in Morgantown in Morgan County, Columbus in Bartholomew County, and Bloomington in Monroe County, and the surplus wheat grown is sold to elevators there. A large part of the corn and hay are consumed locally.

Consolidated grade schools and high schools are maintained at Nashville and Helmsburg, and grade schools are maintained throughout the county. Students in the outlying districts are transported to and from the consolidated high schools by bus.

Free mail-delivery service is available to practically all parts of the county. Not many farms have telephone service, and few have electric current. Gas is not available.

CLIMATE

The climate of Brown County is humid, temperate, and continental. The temperature and rainfall vary somewhat from year to year, and changes are often sudden.

The rainfall is usually well distributed for agriculture and is ample for the growing of farm crops, except in years of unusual drought. The mean annual precipitation at Hickory Hill is 40.98 inches, of which an average of 21.99 inches falls during the growing season (from April to September inclusive).

Differences in elevation, together with the resulting air drainage between the uplands and valleys, causes sharp variations in temperature within a comparatively small area.

In a valley in the northwestern part of the county the annual mean minimum temperature averaged 1.3° F. lower than at the United States Weather Bureau station at Hickory Hill, only a quarter of a mile away and 168 feet higher in elevation. On clear, calm nights instances were noted in which the minimum temperature of the valley ranged from 10° to 20° lower than on the hill nearby. Such conditions account for frost on the valley floors when no frost occurs on the adjacent slopes and hilltops. These irregularities should be considered in laying out orchards and fields for special crops.

The mean annual temperature at Hickory Hill is 54.2°.

The average length of the frost-free season, from the average last killing frost (April 24) to the average first (October 20), is 179 days. This period usually gives ample time for the growing of all farm crops in the area, but on rare occasions late frosts in the spring have severely damaged corn and tomato crops and early freezes in the fall have prevented corn from maturing. Killing frost has been recorded as late as May 25 and as early as September 16. Severe winters without an accompanying snow cover often cause heaving of clovers, alfalfa, and wheat. Severe windstorms are rare, and tornadoes are practically unknown.

Mean temperatures in spring and autumn approach the annual mean, but there is a difference of more than 41.6° between the means of winter and summer.

Table 1, compiled from the records of the station at Hickory Hill, gives normal monthly, seasonal, and annual temperatures and precipitation that are fairly representative of the county.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Hickory Hill, Brown County, Ind.*

[Elevation, 931 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total for the driest year (1930)	Total for the wettest year (1937)	Average snowfall
	°*F.*	°*F.*	°*F.*	*Inches*	*Inches*	*Inches*	*Inches*
December	33.2	66	−16	3.11	0.95	3.70	3.8
January	31.4	68	−20	3.33	8.21	15.55	5.6
February	32.6	78	−9	2.17	3.20	2.21	3.2
Winter	32.4	78	−20	8.61	12.36	21.46	12.6
March	43.4	88	1	3.93	1.87	1.28	1.9
April	53.6	93	15	3.36	2.62	4.42	.6
May	63.8	93	29	3.95	1.70	2.90	(1)
Spring	53.6	93	1	11.24	6.19	8.60	2.5
June	71.7	102	38	3.79	2.35	2.71	.0
July	76.0	108	39	3.35	.30	4.20	.0
August	74.4	105	42	3.51	.93	6.08	.0
Summer	74.0	108	38	10.65	3.58	12.99	.0
September	68.4	103	29	4.03	2.60	6.60	.0
October	57.4	93	15	3.41	1.77	6.10	.3
November	45.0	88	−5	3.04	2.38	1.99	.5
Fall	56.9	103	−5	10.48	6.75	14.69	.8
Year	54.2	108	−20	40.98	28.88	57.74	15.9

1 Trace.

AGRICULTURAL HISTORY AND STATISTICS

The first settlers, who came about 1820, felled trees for houses and other necessary buildings and for fuel. A small area of the better drained land was cleared of trees and planted to needed crops. Food thus produced was supplemented by killing wild game, which was abundant. As settlement progressed, more land was cleared of timber; and corn, wheat, oats, and other staple crops, as well as vegetables, were grown for home use.

Flour and lumber mills were established along the larger streams, which furnished an outlet for produce. Wells were sunk along Middle Fork Salt Creek and its tributaries, and salt was obtained for local use.

At present the principal crops grown are corn, wheat, oats, soybeans, and hay. The latter consists chiefly of timothy, common red clover, and mammoth clover; but alfalfa and lespedeza are gaining in acreage. A small acreage is used for rye, sorgo, and millet. Tomatoes are grown on contract for canning factories in neighboring towns. Some tobacco is grown.

The census for 1940 reports 37,542 acres, or only about 18 percent of the total area of the county, as available for farm crops, that is. in cropland or plowable pasture. The remaining 82 percent is largely given over to timber or has a thick growth of briers, shrubs, and weeds, which is the result of having been allowed to remain idle for a number of years. A large area of idle land and the large number of abandoned farmsteads in a state of ruin testify to a declining agriculture.

Table 2 gives the acreages of the leading crops grown in Brown County in stated years.

TABLE 2.—*Acreage of principal crops in Brown County, Ind., in stated years*

Crop	1879	1889	1899	1909	1919	1929	1939
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
All corn					25,735	8,060	7,144
For grain	15,436	14,252	16,238	16,033	15,821	5,539	7,112
For silage, fodder, and other purposes					[1] 9,914	2,521	[2] 32
Wheat	7,875	7,791	11,206	5,341	5,729	322	396
All oats						992	179
For grain	4,940	5,341	2,079	1,929	2,313	284	11
Cut and fed unthreshed						708	168
Sorgo		354	119		200	2	12
Soybeans						1,256	2,316
Clover seed						101	
Tobacco	251	30	50	7	17	132	151
Potatoes		685	532	773	452	281	139
Tomatoes						183	208
Hay	7,256	13,038	15,096	11,446	9,545	8,386	6,442
Timothy and clover, alone or mixed				10,273	7,414	5,558	2,260
Small grains for hay			237	131	1,044	1,245	1,206
Alfalfa				3	88	55	304
Annual legumes					199	1,254	2,189
Other hay			14,859	1,039	800	274	483
	Trees	*Trees*	*Trees*	*Trees*	*Trees*	*Trees*	*Trees*
Apples [3]		58,262	123,103	88,385	64,504	40,938	19,715
Peaches [3]		20,171	78,666	58,841	31,092	31,801	1,547

[1] For forage only.
[2] For purposes other than grain.
[3] Fruit trees are for the years 1890, 1900, 1930, and 1940, respectively.

The total value of farm, garden, and orchard crops produced in 1939 was $290,628.

On April 15, 1940, the total number of cattle over 3 months of age was 2,732. In 1939, 741,806 gallons of milk was obtained from 1,564 cows. Other livestock on farms were as follows: Horses (over 3 months), 1,068; mules (over 3 months), 265; hogs (over 4 months), 2,648; sheep (over 6 months), 504; and chickens (over 4 months), 37,437.

Practically all of the labor on farms in the county is done by members of the farm family or in exchange of work by persons from neighboring farms.

The county had 883 farms in 1940, an increase of 9 over the number reported in 1930. These farms embraced a total area of 95,637 acres, or 46.1 percent of the area of the county. The size of farms declined from an average of 119.4 acres in 1930 to 108.3 acres in 1940. The average value of land and buildings also decreased during this period from $2,602 a farm and $21.79 an acre in 1930 to $2,267 a farm and $20.93 an acre in 1940. The movement of families from the larger cities, especially Indianapolis, to farms in Brown County probably accounts for this decrease in the size of farms. The 1940 census reports 83.9 percent of the farms in the county operated by owners, 16.0 percent by tenants, and less than 0.1 percent by managers. Tenants pay either cash rent for the use of the land or a share—ranging from one-third to one-half—of the crops produced and livestock raised.

Farm improvements are fair to poor. Work animals consist of average to poor horses and mules. Tractors and other improved farm machinery are not common.

A very small quantity of commercial fertilizer—471 tons—was used by farmers in the county in 1929, owing partly to adverse economic conditions. Only $15,960 was spent for commercial fertilizers, manure, and lime in all forms in that year.

The general system of crop rotation practiced in Brown County is corn, oats or soybeans, wheat, and clover or other legumes. This varies, depending on the soil type, weather conditions, and the individual farm requirements.

Land to be used for growing corn is plowed either in fall or in spring, depending on weather conditions and type of soil. In recent years fall plowing of land susceptible to erosion has been greatly discouraged. Before planting, the ground is usually conditioned with a disk harrow and drag.

Each farmer usually has his own variety of corn, which has been selected over a period of years; but since the introduction of hybrid seed a larger acreage of this has been planted each year. Methods of harvesting the corn vary with the individual farm requirements. It may be cut and shocked in the field, husked in the field, or hogged off. A large part of the corn is fed to livestock on the farm, and the surplus is sold to elevators or stock feeders for cash.

Wheat may follow corn, oats, or soybeans, and it is planted late in September or early in October, usually after the "fly-free' date (the date on which the hessian fly ceases to be a danger), as given by Purdue University Agricultural Experimental Station. When wheat follows corn, it is sown either between the corn rows or after the corn fodder is cut. If wheat follows oats, beans, or tomatoes, the land is plowed or disked and allowed to settle somewhat. Prac-

tically all of the wheat is harvested for grain, and wheat is one of the more important cash crops.

Oats usually follow corn, wheat, or soybeans, or they may be sown when the preceding legume crop has failed. The land is plowed or disked in spring, and seeding is done from late March to early May, depending on weather conditions. Unusually wet springs retard sowing and may result in reduced yields. Hot, dry weather in May and June greatly reduces the yield of both grain and straw. Probably the greater part of the oat crop is harvested for grain in most years, but in years of reduced hay crops it is often cut for hay. A large part of the grain harvested is fed on the farm, and any surplus is trucked to elevators or sold to outside livestock feeders.

Rye may take the place of wheat in the crop rotation and is sown early in fall, either between the corn rows or following oats. Rye is favored in those parts of the county where it is not practicable to purchase fertilizer or where soil conditions are not favorable for other crops.

Clover and timothy are seeded in wheat and rye fields early in spring, either broadcast or drilled with oats, or early in fall in a carefully prepared seedbed. An increasing number of farmers are realizing the importance of lime for the successful growing of clover, and, where economic conditions allow, lime is being applied to land before seeding to clover. Owing to the high acidity of most of the soils in Brown County, a heavy application (2 to 4 tons to the acre) is required for satisfactory results.

The superiority of alfalfa as feed is appreciated by many farmers, but good stands are rather difficult to obtain because of the high acidity of most of the soils. Heavy applications of lime are essential for the successful production of this legume. Methods of seeding are similar to those for clover, and a larger proportion of the alfalfa is sown in the fall as compared with clover. In addition to being used as roughage, alfalfa may be cut very fine and used with excellent results in supplementary feeds for hogs, cattle, and poultry.

Because of its tolerance of high acidity, lespedeza is gaining in favor as a hay crop, and its acreage has increased in recent years.

Soybeans are increasing in popularity both as a hay crop and for seed. This is especially true on the poorly drained soils of the bottoms and terraces, where other crops are injured by the wet conditions. They are sown in May or June in a thoroughly prepared seedbed. When wheat or clovers are winterkilled, the land is often seeded to soybeans. The acreage used for this crop varies with the individual needs for hay and current market prices for the beans.

Only a small acreage is used for tomatoes and tobacco, and yields are usually fair to low. Soil conditions are not favorable for either of these crops.

The land used for the growing of vegetables, exclusive of those grown for consumption in the home, varies from year to year, but is usually small. Vegetables are marketed at Columbus, Bloomington, or Indianapolis. Because of the distance to market and competition with other counties having more favorable soils, financial returns are usually unsatisfactory.

The Federal census of 1940 reported a total farm population in Brown County of 6,189, an average of about 19.1 to the square mile.

The problems and difficulties of farm management in Brown County are somewhat different from those in the adjacent counties. Federal and State agencies have purchased a large acreage of land in the southern and western parts of the county and have retired it from agricultural production. The Brown County State Game Preserve covers 11,400 acres, and the Pleasant Run Purchase Unit has acquired tracts amounting to 7,246 acres, which are under the administration of the United States Forest Service and intended ultimately for a National Forest. One of the problems of the remaining farmers is that the retirement of this land has resulted in a higher tax rate to support the county government.

SOIL SURVEY METHODS AND DEFINITIONS

Soil surveying consists of the examination, classification, and mapping of soils in the field.

The soils are examined systematically in many locations. Test pits are dug, borings are made, and exposures, such as those in road or railroad cuts, are studied. Each excavation exposes a series of soil layers, or horizons, called collectively the soil profile. Each horizon of the soil, as well as the parent material beneath the soil, is studied in detail, and the color, structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are noted. The reaction of the soil [6] and its content of lime (calcium carbonate) are determined by simple tests. The drainage, both internal and external, and other external features, such as the relief, or lay of the land, are taken into consideration, and the interrelation of the soil and vegetation is studied.

The soils are classified according to their characteristics, both internal and external, with special emphasis upon the features that influence the adaptation of the land for the growing of crop plants, grasses, and trees. On the basis of these characteristics the soils are grouped into classification units; the principal three of local importance are (1) series, (2) type, and (3) phase.

The series is a group that includes soils having the same genetic horizons, similar in their important characteristics and arrangement in the soil profile, and having similar parent material. Thus, the series comprises soils having essentially the same color, structure, natural drainage conditions, and other important characteristics and the same range in relief. The texture of the upper part of the soil, including that commonly plowed, may vary within a series. The soil series are given names of places and geographic features at or near which they were first found. Muskingum, Zanesville, and Pope are names of important soils series in Brown County.

Within a soil series are one or more types, defined according to the texture of the upper part of the soil. Thus, the class name of this texture, such as sand, loamy sand, sandy loam, loam, silt loam, clay loam, silty clay loam, and clay, is added to the series name to give the complete name of the soil type. For example, Pope loam and Pope silt loam are soil types within the Pope series. Except for the texture of the surface soil, these types have approximately the same internal

[6] The reaction of the soil is its degree of acidity or alkalinity expressed mathematically as the pH value. A pH value of 7 indicates precise neutrality; higher values, alkalinity; and lower values, acidity.

and external characteristics. The soil type is the principal unit of mapping, and because of its specific character it is usually the soil unit to which agronomic data are definitely related.

A phase of a soil type is a variation within the type, differing from the type in some minor soil characteristic that may have practical significance. Differences in relief, stoniness, and the degree of accelerated erosion are frequently shown as phases of a soil type. For example, within the normal range of relief for a soil type some areas may be adapted to the use of machinery and the growth of cultivated crops and others may not. Even though there may be no important difference in the soil itself or in its capability for the growth of native vegetation throughout the range in relief, there may be important differences in respect to the growth of cultivated crops. In such instances the more sloping parts of the soil type may be segregated on the map as a sloping or a hilly phase. Similarly, soils having differences in stoniness may be mapped as phases, even though these differences are not reflected in the character of the soil or in the growth of native plants.

The soil surveyor makes a map of the county or area, showing the location of each of the soil types, phases, and other land types, in relation to roads, houses, streams, lakes, section and township lines, and other local cultural and natural features of the landscape.

In Brown County aerial photographs, on a scale of approximately 1:20,000 inches, were used in mapping the soils. A transparent sheet was placed over each photograph, and soil boundaries, drainage, and roads, were drawn on this sheet in the field. After completion of the mapping in the field the maps were reduced to a scale of 2 inches to 1 mile, to correspond with the base map, and assembled on heavy transparent material. They were then sent to the lithographer in Washington to be reproduced for publication on the scale of 1 inch to the mile. The base map was constructed according to information derived from the aerial photographs, controlled by some General Land Office data and a few geodetic points located by the United States Geological Survey.

SOILS AND CROPS

The soils of Brown County cover a rather broad range of color, moisture conditions, fertility, slope, stoniness, and degree of erosion. These characteristics are significant in determining soil productivity, and one or more of them may limit the agricultural usefulness of the various soils. Except for some of the soils of the stream flood plains, the surface texture of nearly all of the soils in this county ranges from silt loam to stony silt loam. The texture of the alluvial soils ranges from flaggy loam to silt loam. Drainage conditions range from excessive to poor. In the imperfectly drained soils the color ranges from light gray to very dark gray. Different degrees of slope are recognized and mapped. The more severely eroded areas are separated on the map as eroded and gullied phases.

Because of a lack of any well-planned soil-conservation program in the past and the failure to recognize the destructive consequences of cropping steep slopes, especially without a winter cover crop, serious erosion has developed in the county. On many of the soils a large part, if not all, of the surface soil has been eroded away, carrying away valuable plant nutrients and spoiling the tilth of the

remaining soil. Many areas are so badly eroded as a direct result of improper cropping that they are practically unfit for agricultural use. Water erosion on the more rolling types is very severe where clean cultivation has been practiced. The organic content of most of the soils is low.

The system of agriculture practiced in Brown County is typical of that prevailing throughout the adjacent regions having similar soil types. In many places little attention is given to the local adaptation of crops to the soils. This is especially true of the comparatively unproductive soils of steep areas that are susceptible to severe sheet and gully erosion. For the most part a mixed system of farming is practiced, which includes the raising of some livestock for the consumption of the crops grown.

Based on the soil characteristics mentioned above, 24 soil types, 10 phases, and 1 complex were differentiated and mapped in this county. For the purpose of discussing their agricultural uses and relative value, the soils of Brown County are arranged into the following groups: (1) Soils developed from residual materials; (2) soils developed from glacial till; (3) soils developed from stream-terrace deposits; and (4) alluvial soils.

The distribution of these soils is shown on the accompanying soil map, and the acreage and proportionate extent are given in table 3.

TABLE 3.—*Acreage and proportionate extent of the soils mapped in Brown County, Ind.*

Type of soil	Acres	Percent	Type of soil	Acres	Percent
Zanesville silt loam	24,000	11.6	Fincastle silt loam	64	(1)
Zanesville silt loam, eroded phase	3,840	1.9	Otwell silt loam	192	0.1
Tilsit silt loam	1,024	.5	Otwell silt loam, slope phase	960	.5
Wellston silt loam	12,992	6.3	Otwell silt loam, eroded phase	128	.1
Wellston silt loam, slope phase	2,752	1.3	Haubstadt silt loam	1,472	.7
Muskingum silt loam, colluvial phase	704	.3	Elkinsville silt loam	256	.1
Muskingum stony silt loam	111,936	54.0	Pekin silt loam	896	.4
Wellston-Muskingum complex	1,152	.6	Bartle silt loam	1,280	.6
Cincinnati silt loam	2,496	1.2	Peoga silt loam	512	.2
Cincinnati silt loam, slope phase	6,464	3.1	Pope silt loam	14,016	6.8
Cincinnati silt loam, eroded phase	64	(1)	Pope silt loam, high-bottom phase	192	.1
Cincinnati silt loam, gullied phase	896	.4	Pope loam	960	.5
Cincinnati silt loam, shallow phase	3,968	1.9	Pope flaggy loam	4,928	2.4
Gibson silt loam	1,600	.8	Philo silt loam	3,776	1.8
Avonburg silt loam	320	.2	Philo loam	320	.2
Clermont silt loam	64	(1)	Stendal silt loam	2,112	1.0
Parke silt loam	64	(1)	Atkins silt loam	896	.4
Russell silt loam	64	(1)	Total	207,360	100.0

1 Less than 0.1 percent.

SOILS DEVELOPED FROM RESIDUAL MATERIALS

The group of soils developed from residual materials consists of soils developed in materials that are products of the disintegration and of decomposition of interbedded sandstone and shale of the Borden group.[7] The greater part of the area comprises a severely dissected plain with long, narrow ridges, steep slopes, and relatively narrow stream bottoms. All the soils are light colored and well drained. In cultivated areas they are very easily eroded, especially on the steeper slopes, and, where erosion has been allowed to proceed unchecked, large areas are no longer fit for agricultural use.

7 Discussion of geological formations is based on the Handbook of Indiana Geology. (See footnote 2, p. 3.)

The land-retirement programs of the Federal and State agencies have removed a large part of these soils in the western and southern parts of the county from agricultural production. Purchases have been made with a view of converting the area into a permanent forest. At present a large part of the remaining area of these soils is given over to forest or pasture or is allowed to remain idle. Weeds, briers, sassafras, sumac, and brush usually take possession of the idle land. A large area of the idle land is at present so badly eroded as to be unfit for agricultural use.

Members of the Zanesville, Tilsit, Wellston, and Muskingum series are included in this group.

Zanesville silt loam.—This is a well-drained soil occupying the broader ridge tops in the sandstone and shale area. Where cultivated, the surface soil is grayish-brown loose friable silt loam to a depth of about 8 inches. Little organic material remains except in areas that have recently been cleared of timber. Roots penetrate this layer easily. The subsoil to a depth of about 27 inches is yellowish-brown silty clay loam that breaks into coarse-granular aggregates in the upper part and into subangular nutlike aggregates in the lower part. Roots and water penetrate this layer without apparent difficulty. When wet this subsoil is very sticky. Under this layer the material is mottled yellow and brown heavy compact silty clay loam. Gray coatings are along the cracks that separate the structure aggregates. In place the material is compact and firm, and it breaks into medium to large more or less angular blocky pieces ½ to 1 inch or more in diameter. This heavy material checks the downward movement of moisture to some extent. Bedrock of sandstone and shale in most places lies at a depth of 4 to 5 feet. The reaction is strongly acid throughout.

This soil is very susceptible to erosion, and continued cropping to corn, wheat, and other clean-cultivated crops causes severe sheet and gully erosion. When a rotation system of corn, wheat, and 2 or 3 years of hay is followed, erosion may be retarded. This soil should never be allowed to remain without a cover crop during the winter.

Yields of 60 bushels of corn and 30 bushels of wheat to the acre have been obtained the first few years of cropping after clearing this soil of trees, but the organic material and general fertility are soon lost with continued cultivation. At present, yields of 15 to 40 bushels of corn and 8 to 15 bushels of wheat to the acre are obtained. The higher yields are those obtained on areas that receive good management. The acreage in soybeans has increased in recent years, and yields of ½ to 2 tons are obtained. When areas used for soybeans are allowed to remain over the winter without a cover crop, such as wheat or rye, large quantities of the surface soil are removed by water erosion.

Apple orchards do well on Zanesville silt loam, and production is maintained in well-managed orchards when one-fourth pound of sulfate of ammonia per tree per annum is applied. Soil-improving crops are essential to the maintenance of the fertility of this soil, and without them crop yields are soon lowered. Some barnyard manure is applied before plowing for corn, and small quantities of commercial fertilizer are used for corn and wheat. Very little oats are grown on this soil, as yields usually are too low to encourage planting.

Common red clover, mammoth red clover, and timothy, the chief hay crops grown, return fair to good yields. A small acreage is used for alfalfa, but unless large quantities (3 to 5 tons an acre) of ground limestone are applied, good stands are difficult to obtain Because of its tolerance of acid soils, lespedeza is gaining in favor as a hay crop on Zanesville silt loam.

Zanesville silt loam, eroded phase.—The eroded phase of Zanesville silt loam includes these areas having a slope steeper than 8 percent, where severe sheet or gully erosion, or a combination of both, has occurred. Three-fourths or more of the original surface soil (that part of the soil generally plowed) has been removed by accelerated water erosion, exposing the brownish-yellow, relatively unproductive subsoil. The removal of the surface soil also removed a large part of the plant nutrients, seriously impaired the tilth, and greatly lowered the productivity. Many areas are at present so badly eroded as to be destroyed for agricultural use. Attempts have been made toward reforestation of these more severely eroded areas, but results have been unsatisfactory in many instances. Soil-conserving practices have checked erosion on the less seriously eroded areas, and poor to fair stands of pasture have been obtained. Undoubtedly the best use for this soil phase is for forest.

As mapped, Zanesville silt loam, eroded phase, includes many areas of Wellston silt loam, eroded phase, which are combined with it because the two soils are very similar and both have little or no agricultural value.

Tilsit silt loam.—This soil occupies the nearly level broad ridge tops and local flats in the sandstone and shale area. It occurs back from the steeper slopes, and therefore erosion is not a serious problem.

The surface soil is grayish-brown friable silt loam to a depth of about 8 inches in the cultivated areas. The organic-matter content is low even in newly cleared areas, and it is further depleted by ordinary farming. To a depth of about 15 inches the subsoil is pale brownish-yellow heavy silty clay loam. This material breaks into coarse-granular and nutlike aggregates about one-fourth to one-half inch in diameter. Roots penetrate this layer with little difficulty. It is underlain to a depth of 32 inches by mottled yellow and gray silty clay loam. Mottling occurs in an irregular pattern, in many places as blotches and streaks, increasing in intensity with depth. This material breaks into subangular aggregates, three-eights to one-half inch in diameter, which may be crushed, with difficulty, into smaller granules. Between depths of about 32 and 44 inches is a layer of mottled gray and yellow heavy compact silty clay loam. In place the material is firm and compact, and it breaks into large subangular aggregates, in many places appearing as vertical columns. On drying, this layer becomes very hard. Below it, to a depth of about 55 inches, is mottled gray and yellow silty material, contrasting noticeably with the heavy compact layer above. This material is underlain by siltstone, sandstone, and shale, which are the parent rocks. Because of the occurrence of Tilsit silt loam on slopes of less than 3-percent gradient, erosion is not a serious problem in the management of this soil, consequently a larger proportion is under cultivation than of associated soils that occupy more sloping areas. Except in newly cleared areas, the organic-matter content

is low, and additions in the form of barnyard manure and green manure are essential in order to maintain proper tilth and a constant supply of nitrogen.

In general the rotation system practiced on this soil is corn, wheat, or rye, followed by 1 or 2 years of some legume or timothy. Corn yields range from 15 to 45 bushels an acre. The higher yields are obtained under good management, which includes the liberal use of fertilizers. When this soil is cropped to corn for 2 or more consecutive years the supply of plant nutrients is materially depleted.

Wheat yields range from 6 to 20 bushels an acre, depending on seasonal conditions and the quantity of fertilizer used at seeding time. Rye occasionally takes the place of wheat in the rotation system and yields 5 to 16 bushels an acre. The total acreage planted to oats on this soil is small, and yields are rather unsatisfactory. Soybeans are increasing in importance in the rotation system.

The strong acidity of Tilsit silt loam necessitates the use of generous quantities of lime in some form for the continued successful growing of clovers and alfalfa. Clovers and timothy are generally sown in spring in wheat, rye, or oats, which act as a nurse crop. Yields of from ½ to 3 tons an acre of clover are obtained, with an average of about 1½ tons. Some alfalfa is grown, but good stands are hard to maintain even after liberal applications of lime. Several farmers are experimenting with lespedeza as a substitute for clovers, with varying results.

Wellston silt loam.—This soil occupies the narrow ridge tops and the outer rim of the broader upland flats in the area of residual soil materials.

In cultivated areas the 7- or 8-inch surface layer is grayish-brown friable granular silt loam. As in the associated Zanesville and Tilsit soils, the organic-matter content of this layer is low and not very stable. Below this, and reaching to a depth of about 30 inches, the subsoil is brownish-yellow to yellowish-brown silty clay loam. The upper part of this layer breaks into coarse-granular to fine nutlike aggregates, and the lower part breaks into medium-sized nutlike aggregates. Here and there a slight gray and yellow mottling occurs in the lower part. This layer is underlain by the parent rock of sandstone and shale.

The occurrence of this soil in relatively narrow bands adjacent to steeply sloping areas makes its value for the production of crops materially below that of Zanesville and Tilsit soils. Surface drainage generally is rapid, and water erosion removes much soil from cultivated areas. The slope of typical Wellston silt loam ranges from 2 to about 10 percent. Steeper areas of this soil are included in the slope phase.

At present only a small part of the land is being used for agricultural purposes. The cultivated land is used for the growing of corn, wheat, rye, and clovers. Corn may be expected to yield from 5 to 30 bushels and wheat from 5 to 12 bushels an acre. Timothy and clovers produce only fair yields, and good stands are uncommon. In the past large areas of this soil have been cleared of timber and cultivated. Rapidly reduced productivity and serious erosion have resulted, causing the areas to be abandoned for the production of crops. At present these areas have a growth of weeds, briers, and

shrubs, and natural reforestation is beginning in those areas that have been idle for 12 years or more. An oak-hickory association of trees occurs on the forested areas of this soil, with chestnut oak predominating in numerous areas.

Wellston silt loam, slope phase.—The slope phase of Wellston silt loam includes areas having a slope steeper than 10 percent, but in most places little or no accelerated erosion has taken place, because it is protected by a forest cover. Areas of this soil that have undergone sheet or gully erosion are separated and combined on the map with Zanesville silt loam, eroded phase. The characteristics of the soil profile are comparable to those of Wellston silt loam, except that the layers are somewhat thinner. It occurs in sloping areas adjacent to areas of Wellston and Zanesville soils, and in many places these areas lie just above areas of Muskingum stony silt loam. A few areas of this soil are in apple orchards, and production and growth appear to be as good as or better than on the smoother areas of Wellston silt loam. This condition is probably due to the fact that the slopes receive the surplus moisture from the ridge tops.

Muskingum silt loam, colluvial phase.—An accumulation of material at the foot of steep slopes is mapped as Muskingum silt loam, colluvial phase. This soil has no definite profile but consists of a mixture of silt, clay, and rock fragments of all sizes that have slumped and washed down from the slope above. Areas generally are more or less fan-shaped. Where the soil is comparatively free of rock to a depth of 8 to 10 inches, it is used for the growing of hay or is occasionally planted to corn or wheat. Because of the presence of numerous stones throughout the soil mass, however, yields are low. The predominant cover is low-grade pasture or a mixture of briers, weeds, and shrubs.

Muskingum stony silt loam.—This soil occupies the steeper slopes in the area of residual soil materials. It occurs in large areas throughout the western and southern parts of the county. These areas include most of the steepest land in the county, in a few places having a gradient of less than 15 percent. The 3-inch surface soil is dark grayish-brown to brownish-gray friable loose stony silt loam. The organic matter from the decomposed leaves and twigs of the forest vegetation darkens this layer somewhat. This is underlain to a depth of about 15 inches by grayish-brown to pale yellowish-gray stony silt loam. The material breaks out into coarse-granular aggregates. Below this is bedrock of sandstone and shale. Because of steep slope and the presence of numerous stones on the surface and throughout the subsoil, this soil is not suited for agricultural production. It supports an oak-hickory forest association for the most part. Some areas have been cleared of timber and at present support a poor grade of pasture, which generally consists largely of poverty grass, or a growth of weeds, briers, and shrubs. In 1936 a few small areas of this soil were planted to corn, but yields were very low.

Wellston-Muskingum complex.—This soil complex occupies the very narrow ridge tops surrounded by more or less steeply sloping areas of Muskingum stony silt loam. Most of these ridge tops are less than 150 feet wide, and surface drainage is excessive.

The Wellston-Muskingum complex consists of small areas of Well-

ston silt loam intermingled with areas of Muskingum stony silt loam. Stones are numerous in the areas of the Muskingum soil, but the Wellston soil is practically free of stone. These soils are underlain by bedrock of siltstones, sandstones, and shales. The stony parts of this complex are practically unfit for agricultural production. The chief uses made of this soil complex at present are for forests, for pasture that is poor in quality, as the growth consists of briers, weeds, and shrubs, and for small patches of cultivated crops on the parts consisting of Wellston silt loam.

SOILS DEVELOPED FROM GLACIAL TILL

The soils developed from glacial till are derived from both Illinoian and early Wisconsin glacial tills. Calcium carbonate has been removed in solution to an average depth of about 10 feet in the Illinoian till and to an average depth of about 5 feet in the early Wisconsin till.

The soils developed from material of the Illinoian glaciation include members of the Cincinnati, Gibson, Avonburg, Clermont, and Parke series. Each of these soils has a light-colored silt loam surface horizon and is leached of lime to an average depth of about 10 feet.

Russell and Fincastle silt loams are the only soils in Brown County developed from the early Wisconsin glacial till. They occupy less than 1 square mile in the northeastern part of the county. In general they differ from the soils developed on Illinoian till in containing appreciable quantities of grit and pebbles in the subsoil, in being less acid, and in being underlain at a depth of about 54 inches by calcareous till.

Cincinnati silt loam.—In cultivated areas, Cincinnati silt loam has a surface soil of light-brown to grayish-brown friable smooth silt loam to a depth of about 7 inches. Except in areas recently put into cultivation, the organic-matter content of this layer is low and not very stable. The material is coarsely granular, and tilth conditions are good. The surface layer is underlain to a depth of about 30 inches by yellowish-brown or brownish-yellow heavy silt loam, or, in places, by light silty clay loam. The coarse-granular structure in the upper part changes with depth to small subangular aggregates. A few small pebbles are present in this layer. Between depths of 30 and 36 inches the material is yellowish-brown heavy silty clay loam that breaks into medium-sized subangular aggregates, with a tendency toward vertical columnar structure. A thin coating of gray silty material is on the cleavage faces. When dry this material becomes compact and hard. It grades into more friable yellow, brown, and gray mottled gritty silty material, which rests on calcareous till—a mixture of silt, rock flour, and pebbles—at a depth of about 10 feet. Small areas of Cincinnati silt loam occur on the narrow ridge tops and as a fringe between the upland flats and adjacent slopes in the northern and eastern parts of the county.

Surface drainage is rapid to very rapid. The slope of Cincinnati silt loam is less than 8 percent. The steeper areas are separated on the map as slope, eroded, and gullied phases.

In general, a rotation including corn, wheat, and clover is followed on Cincinnati silt loam. As the organic-matter content is naturally low and is not very stable, generous replenishments are required to

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maintain production. Corn may be expected to yield from 10 to 35 bushels and wheat from 5 to 18 bushels an acre. When good management practices are maintained and commercial fertilizers are applied, the higher figure may be obtained; but the average yields are probably about the average of the above figures. Rye takes the place of wheat on a part of this soil, and yields of from 5 to 12 bushels an acre are obtained. Very little if any commercial fertilizer is used on rye. Clovers grown include common red and mammoth varieties, usually mixed with timothy. Because of the high acidity of this soil, liberal applications of lime are required for obtaining good stands of alfalfa. Clover crops are materially improved by liming, but, because of adverse economic conditions, or a lack of appreciation of the benefits to be derived from such practices, few farmers use lime in any form.

Because this soil is very susceptible to water erosion, extreme care is required to prevent serious damage from this source. Clean-cultivated crops, such as corn, should always be followed by a winter cover crop of wheat or rye to hold the surface soil in place. Plowing under green manure and other organic material improves the physical structure of the soil, helps to hold moisture, and thus aids in preventing excessive runoff of surface water.

Considerable areas of Cincinnati silt loam are in pasture or in forests or are idle. Most of the pastures are inferior in quality, being composed largely of broomsedge and poverty grass. Idle land includes those areas that were formerly cultivated but at present for various reasons are temporarily abandoned. A growth of briers, sumac, and various weeds have taken over the abandoned land and have reduced its economic value to a very low level.

Cincinnati silt loam, slope phase.—The slope phase of Cincinnati silt loam includes areas that have a slope of more than 8 percent but have not undergone much accelerated erosion because most of them are protected by a forest cover. The soil profile is similar to that of Cincinnati silt loam, except that the corresponding layers are somewhat thinner. A few small areas are in pasture. When the forest cover is removed and the land cultivated, the surface soil may be quickly eroded. Thus it is best to use this soil for forestry.

Cincinnati silt loam, eroded phase.—Areas of Cincinnati silt loam having lost three-fourths or more of the surface soil by water erosion are shown on the soil map as the eroded phase. In many areas all the surface soil has been removed, together with a part of the upper subsoil layer. As a direct result of the failure to handle this soil properly, a large part of the valuable plant nutrients have been lost and production has been greatly reduced. This soil has been planted to corn, wheat, or other grain without the use of clovers and other legumes to prevent erosion. Some areas are allowed to remain over winter without a protective cover crop of wheat or rye, and as a result a large quantity of the surface soil may be eroded away in a single winter.

At present a part of this phase is being used for growing corn, wheat, rye, and soybeans, but yields are extremely low and may be reduced with each succeeding crop. A large acreage at present is idle, having been taken out of agricultural production, and supports a growth of weeds, broomsedge, briers, poverty grass, and a

scattering of shrubs, such as sassafras and sumac. All areas of this phase should be retired from agricultural production, with the exception of a few of the less severely eroded areas, which might be placed under a cover of permanent pasture. Reforestation, to retard the erosion, is probably the best use for these areas.

Cincinnati silt loam, gullied phase.—The gullied phase of Cincinnati silt loam includes those areas in which uncontrolled erosion has been so severe that numerous gullies have formed. These gullies generally are 2 feet or more deep and in most areas are so numerous that the land cannot be used for crops or pasture. Attempts have been made in recent years to reforest these areas, but without favorable results.

Cincinnati silt loam, shallow phase.—In numerous areas, principally in the northern and eastern parts of the county, a thin layer of glacial material, ranging from 30 to 70 inches in depth, rests on the siltstone, sandstone, and shale.

In cultivated areas the 7-inch surface layer is grayish-brown friable smooth silt loam. As in Cincinnati silt loam, the organic-matter content is low. Below this, to a depth of about 30 inches, is yellowish-brown or brownish-yellow silt loam, with a coarse-granular structure in the upper part and grading with depth into heavy silt loam or light silty clay loam material. This breaks into medium-sized nutlike aggregates, about the size of hazelnuts. Below this the material is variable, depending on the depth to bedrock. In areas where depth to bedrock is greatest, the material underlying the above layer is yellowish-brown heavy silty clay loam with a thin coating of smooth silty gray material on the cleavage faces. In place it is firm, and it breaks out into medium-sized subangular aggregates. This layer generally is about 6 inches thick and extends to a depth of about 36 inches. Below this and above bedrock is somewhat friable gray and yellow mottled material containing varying quantities of small rounded pebbles. The layer of calcareous glacial till characteristic of typical Cincinnati silt loam is nowhere present in this shallow soil.

Surface drainage is rapid, and only small areas are cultivated. Crops grown include corn, wheat, rye, and some clover. The greater part is used for forest or, if allowed to remain idle, has grown up to poverty grass, weeds, broomsedge, briers, and sassafras. Some of the cleared areas are used for pasture, but the quality is very poor.

The shallow phase of Cincinnati silt loam, as shown on the map, includes several small areas of soil that is similar to Gibson silt loam in the upper part of the profile, but which, like Cincinnati silt loam, shallow phase, with which it is included, is underlain at a depth of from 3 to 6 feet by sandstone and shale bedrock instead of by calcareous till, as is typical of Gibson silt loam. This inextensive inclusion occurs in the north-central part of the county. The 7-inch surface layer is grayish-brown friable silt loam, with a granular structure and good tilth. Underlying this to a depth of about 15 inches is pale-yellow silt loam with a coarse-granular to fine nutlike structure. Below this is mottled gray and yellow heavy silt loam that breaks into small to medium-sized subangular aggregates. This layer extends to a depth of about 30 inches, where mottled gray and yellow heavy compact clay loam is reached. The thickness of this compact material generally is about 7 inches, but it is less in places, depending on the

depth to bedrock. Small rounded and angular pebbles are present below a depth of 7 inches, and a few larger stones are present in some places at the lower depth. Where depth to bedrock is greater, a layer of mottled gray and yellow silty material occurs below the heavy indurated layer.

The chief uses to which this included soil is put are pasture, forest, and idle land. The pasture generally is of poor quality, as the cover consists of less than 30 percent bluegrass. The remainder is principally broomsedge and poverty grass. Idle land consists of areas that formerly were under cultivation, but which at present support a growth of briers, poverty oatgrass, and shrubs. A few small areas are planted to corn, wheat, and timothy, but yields are low.

Gibson silt loam.—This soil is only slightly less well drained than Cincinnati silt loam and occupies the broader ridge tops in the Illinoian glacial till region. As there is generally a strip of Cincinnati silt loam between the slopes and areas of this soil, erosion is not a serious problem in its management.

In cultivated areas the 7-inch surface soil is grayish-brown friable smooth silt loam. The organic-matter content is low, and tilth conditions are fair to good. This layer is underlain to a depth of about 15 inches by pale-yellow to brownish-yellow friable silt loam. It grades into mottled gray and yellow silt loam having a coarse-granular structure. At a depth of about 30 inches is heavy compact mottled gray and yellow clay loam that breaks into large subangular nutlike aggregates and extends to a depth of about 36 inches. Below this is friable smooth gray and yellow mottled silty material. This grades into gray and yellow mottled silt, clay, and gritty material, and this in turn grades into calcareous gray till at a depth of about 10 feet.

The gently undulating surface of Gibson silt loam affords good surface drainage but does not induce serious erosion. A general rotation system including corn, wheat, and clover and timothy is practiced, and a few small areas are planted to soybeans. Yields of from 15 to 45 bushels of corn to the acre may be expected, depending on weather conditions and the state of fertility. As organic matter is naturally deficient, replenishment of it, in the form of barnyard manure and vegetable matter plowed under, is necessary to maintain fertility. Wheat yields from 6 to 20 bushels an acre, and rye from 5 to 15 bushels. As on Cincinnati silt loam, liberal applications of lime are necessary for continued good results with the clovers and alfalfa.

Avonburg silt loam.—This is an imperfectly drained soil of the broader ridge tops and local upland flats in the area of Illinoian till. The surface is nearly level, and surface and internal drainage are poor. The 7-inch surface layer is brownish-gray smooth friable silt loam that has a fine-granular structure. The organic-matter content is low. Beneath this layer, to a depth of about 34 inches, is mottled gray and yellow silt loam. This changes rather abruptly to mottled yellow and gray heavy compact silty clay loam. This layer is almost impervious to moisture and greatly retards the downward movement of water in periods of abundant rainfall. This impervious layer generally extends to a depth of about 50 inches. Beneath this is mottled gray and yellow silty material, which rests on calcareous glacial till material of silt, clay, and rock fragments, at a depth of about 10 feet.

Only a few small areas of Avonburg silt loam are mapped in the county. Artificial drainage is required before cropping can be undertaken because of the presence of the heavy impervious layer. Dead furrows or shallow open trenches are made about 2 rods or more apart to provide surface drainage and allow cultivation. This soil remains so cold and wet in spring that cropping is retarded and clovers and timothy are out of consideration as suitable crops unless artificial drainage is provided.

Clermont silt loam.—This soil occurs on the flat upland areas well back from the drainageways. It is the most poorly drained soil developed from Illinoian till in Brown County.

To a depth of 6 inches the surface soil consists of gray friable smooth silt loam and contains numerous small iron concretions and iron stains. The organic-matter content is low. Numerous crawfish chimneys are present and the soil is known locally as crawfish or slash land. Below the surface layer the material is intensely mottled gray and yellow silt loam or silty clay loam. The structure of the upper part is coarsely granular but with depth the structural aggregates become small and nutlike. At a depth of 36 inches the soil changes abruptly to mottled gray and yellow heavy compact silty clay loam to silty clay, which extends downward to a depth of about 50 inches. The material breaks into medium-sized subangular aggregates and generally shows a tendency toward prismatic or columnar structure. This layer is similar to the heavy layer in Avonburg silt loam and is impervious to moisture. Below this is a layer of mottled gray and yellow silty material containing iron stains somewhat intensified in the lower part and generally comparatively free of grit in the upper part. At a depth of about 120 inches is calcareous till composed of a mixture of clay, silt, and rock particles.

Because of extremely poor drainage, Clermont silt loam is cropped with difficulty, and yields are low. Artificial drainage is necessary for the production of crops, and either tile or open ditches placed 1 rod or more apart have been used. At the time this survey was made (1936), however, no attempt was being made to plant crops on this soil, and a cover of poverty grass, weeds, and broomsedge had sprung up.

Parke silt loam.—This is a well-drained soil that occurs in small isolated areas associated with the Cincinnati soils in the area of Illinoian till. The 6-inch surface layer is grayish-brown friable silt loam with a granular structure. Underlying it to a depth of about 18 inches is yellowish-brown to faint reddish-brown sandy clay loam. This material is more compact than the surface layer and contains a few small pebbles. Below it is brownish-red heavy sandy clay loam that is compact in place but breaks into irregular-sized subangular aggregates. Numerous pebbles and small stones occur, as do dark-brown and black spots or blotches of iron or manganese. Below a depth of 36 inches the material becomes less firm, contains a large quantity of rounded stones and pebbles, and is somewhat stratified in places.

Owing to rapid external and internal drainage and to occurrence in small isolated sloping areas, Parke silt loam is used for forest or pasture. Oak generally is the predominant tree, and pasture generally is of a poor quality.

Russell silt loam.—This is a well-drained soil that occupies small isolated areas in the northeastern part of the county. The surface layer is grayish-brown smooth friable silt loam, about 7 inches deep. When it is wet the color is decidedly brown. This layer is underlain by yellowish-brown heavy silt loam to a depth of about 15 inches, where the material becomes brownish-yellow heavy silty clay loam that is generally free of gritty material and breaks into medium-sized subangular aggregates. In place the material is faintly mottled, owing to the presence of a thin coating of gray silty material on the cleavage faces; but this color disappears when the soil is pulverized. Between depths of 34 and 54 inches the material is brownish-yellow heavy silty clay loam containing iron stains in the upper part and numerous pebbles and rock fragments in the lower part. Below this is calcareous till, composed of a mixture of silt, clay, and stones.

Normally Russell silt loam is a productive soil and is extensively cultivated, but, because in this county it occurs in small isolated areas intermingled with the Cincinnati soils, its use is restricted largely to pasture and forests.

Fincastle silt loam.—This is an imperfectly drained soil that occurs in small areas in association with Russell silt loam in the northeastern part of the county.

The 7-inch surface layer is brownish-gray friable silt loam with a fine-granular structure. This is underlain by mottled gray and yellow heavy silt loam that breaks into small subangular aggregates. At a depth of about 30 inches the soil is mottled gray and yellow heavy silty clay loam. This material breaks into irregular-sized subangular aggregates and is not so smooth as the material above. Calcareous till of clay, silt, and grit lies at a depth of 54 inches.

In 1936 this soil was in pasture and forest. The pasture consisted of Kentucky bluegrass, Canada bluegrass, and poverty oatgrass.

SOILS DEVELOPED FROM STREAM-TERRACE DEPOSITS

The soils of stream terraces are developed from two kinds of materials: (1) Those composed largely of sand, silt, and clay of glacial-fluvial outwash material; and (2) those composed of silts and clays of the younger low-terrace deposits.

The soils formed from glacial-fluvial outwash material occur principally along Bean Blossom Creek, North Fork Salt Creek, and Middle Fork Salt Creek. They lie several feet above the stream bed and in a few instances are 30 feet above the valley floor. These soils are all light-colored, strongly acid in the surface soil and subsoil, and well or moderately well drained. Included in this subgroup are the Otwell and Haubstadt soils.

The soils developed from silts and clays of low-terrace deposits of mixed origin occur adjacent to the bottom lands, especially along the larger streams in the county. They were formerly subject to overflow from the streams, but as the streams cut deeper they were left as terraces. Numerous areas are only 1 or 2 feet above the recently deposited alluvium. All the soils are light-colored, are strongly acid in the surface soil and subsoil, and range in drainage from rapid to very slow. Included in this subgroup are the Elkinsville, Pekin, Bartle, and Peoga soils.

Otwell silt loam.—This is a well-drained soil occurring in rolling areas of the glacial-fluvial terraces. To a depth of 6 inches the surface

soil is yellowish-brown mellow silt loam with a semiplaty structure. This is underlain by yellowish-brown silty clay loam that becomes plastic when wet and in which remnants of old laminations may be seen. At a depth of about 30 inches dark-yellow heavy silty clay loam is reached. This material is compact in places and breaks out into medium to large subangular particles that have a tendency toward a columnar structure. The thickness of this layer varies, but generally it extends to a depth of about 50 inches and overlies stratified sand, silt, and clay. This material is mottled gray and yellow in the upper part and with depth generally becomes pale yellow stained and blotched with gray and iron-rust brown.

Only a few small areas of Otwell silt loam are mapped, and they are all in timber or pasture. Pastures support a growth of bluegrass, poverty oatgrass, broomsedge, and weeds, and are of poor quality.

Otwell silt loam, slope phase.—The slope phase of Otwell silt loam occurs on areas that have a slope of over 10 percent but that have undergone very little accelerated erosion because they are mostly forested. After the timber is removed, erosion is likely to take place. The soil profile is very similar to that of Otwell silt loam, except that the upper layers are somewhat thinner. There are only one or two small areas of pasture.

Otwell silt loam, eroded phase.—The eroded phase of Otwell silt loam includes sloping areas in which severe sheet and gully erosion has taken place. A large part, if not all, of the surface soil has been removed, and the heavier subsoil is exposed. In numerous areas gullies have formed, making the areas unfit for agricultural use. At present this soil supports a growth of less than 10 percent of bluegrass. Poverty grass, weeds, briers, and shrubs form the rest of the cover. A few attempts have been made to reforest this eroded soil, and forestry is undoubtedly the best use for it.

Haubstadt silt loam.—The 7-inch surface layer of this soil is grayish-brown mellow granular silt loam. In some areas a faint thinplaty structure is evident. The surface layer is underlain to a depth of about 16 inches by pale brownish-yellow heavy silt loam, which breaks into coarse-granular aggregates. The material is smooth and free of pebbles. Below this is mottled yellow and gray silty clay loam that breaks into small nutlike aggregates about three-eighths of an inch in diameter. At a depth of about 32 inches the material changes abruptly to mottled gray and yellow heavy compact silty clay loam. It is firm in place and breaks into subangular pieces about 1 by 2 or 3 inches in size and of roughly prismatic shapes. Some of the prisms have rounded tops. This silty clay loam grades into stratified layers of mottled gray and yellow fine sand, silt, and clay.

The larger areas of Haubstadt silt loam occur in the vicinity of Needmore and Trevlac. A few small areas are planted to corn, wheat, soybeans, and hay; but the greater part of the land is used for pasture or is allowed to remain idle. Corn yields from 10 to 30 bushels an acre, depending on the state of cultivation and the quantity of fertilizer used. Wheat may be expected to yield from 5 to 12 bushels an acre, and soybeans ½ to 2 tons of hay. Because of the strong acidity of the surface soil and the subsoil, liberal applications of lime must be used for growing red clover and alfalfa.

Poverty oatgrass, broomsedge, and a small proportion of bluegrass

furnish inferior grazing on most of the areas that are used for pasture. Idle land supports a growth of various weeds, sassafras, sumac, and poverty oatgrass, and will probably revert to forest if allowed to remain undisturbed.

Elkinsville silt loam.—This is a well-drained soil occupying the higher parts of the low terraces. In many places it borders sloping areas and is therefore subject to accelerated erosion. Areas along the outer edges of the terraces, where the slope exceeds 10 percent, are subject to severe sheet and gully erosion and would have been separated as eroded phases if the total area had been larger.

The 7-inch surface layer of Elkinsville silt loam is grayish-brown or brown smooth friable silt loam. In cultivated areas the organic-matter content is low. This layer grades with depth into yellowish-brown smooth heavy silt loam, which changes into silty clay loam. This material is free of grit and pebbles and breaks into small subangular aggregates. At a depth of about 28 inches it gives way abruptly to yellow or brownish-yellow heavy compact silty clay loam to clay loam that is noticeably free of pebbles and that breaks into subangular aggregates about three-eighths of an inch in diameter. Some evidence of stratification remains. Below a depth of about 34 inches are stratified layers of grayish-yellow to brownish-yellow smooth very fine sand, silt, and clay.

The total area of Elkinsville silt loam is small; and, as it occurs in small isolated areas, its agricultural use is mostly limited to pasture. A few small areas are used for raising corn and wheat, but yields are unsatisfactory. Because of susceptibility to erosion, this soil should be used only for forestry or permanent pasture.

A few small included areas of Elkinsville silt loam that have a slope of over 10 percent and have undergone no appreciable accelerated erosion would have been shown separately on the soil map as Elkinsville silt loam, slope phase, if the total area were larger. The soil profile is similar to that of typical Elkinsville silt loam except that the corresponding layers are somewhat thinner. All these included areas are forested.

Another inclusion comprises a few small eroded areas of Elkinsville silt loam along the narrow edges of the terraces. In these areas a large part if not all of the surface soil has been eroded and the brownish-yellow subsoil has been exposed. Gullies have developed to such an extent in some areas as to make the land useless for cultivated crops. This erosion is a direct result of improper management in cultivation. Some of the land furnishes low-grade pasturage, and some of it is idle. The pasture consists of a small proportion of bluegrass in a growth of broomsedge, poverty oatgrass, and scattered briers. Idle land consists of areas that formerly were in cultivation but at present support a growth of briers, sassafras, sumac, poverty oatgrass, and broomsedge. All this inclusion should be reforested.

Pekin silt loam.—This soil is only slightly less well drained than Elkinsville silt loam and occurs on very gently undulating to nearly level land of the low terraces. The surface 7 inches is grayish-brown friable smooth silt loam. To a depth of about 15 inches the subsoil is pale-yellow smooth heavy silt loam, which breaks into coarse-granular to small nutlike aggregates. Below this is mottled gray and

yellow smooth silty clay loam. At a depth of about 26 inches is mottled gray and yellow compact heavy silty clay loam or silty clay. This material is compact in place and breaks into subangular aggregates three-eighths to three-fourths of an inch in diameter. This layer shows some evidence of stratification and is slowly pervious to moisture. It rests on gray and yellow stratified silts and clays at a depth of about 38 inches. The entire soil generally is free of grit and pebbles.

The total area of Pekin silt loam is small, and it is associated with the Elkinsville and Bartle soils. Cultivated areas are planted to corn, wheat, soybeans, and hay. The organic-matter content is low, and constant replenishment of organic matter is required to maintain good productivity. Good stands of clovers and alfalfa are difficult to obtain because of the strong acidity of the surface soil and the subsoil. In winters of alternate freezing and thawing, clover and wheat are often injured by heaving. A large part of this soil is at present in low-grade pasture and briers.

Bartle silt loam.—This is an imperfectly drained soil occurring on flat river-terrace land, in many places only a few feet above the alluvial plain. The 7-inch surface layer consists of light brownish-gray friable silt loam. The subsoil to a depth of about 22 inches is mottled yellow and gray smooth heavy silt loam with numerous irregular streaks and blotches of rust-brown material throughout the layer. Small black iron concretions are generally present, especially at a lower depth. Below this layer is yellow and gray mottled heavy compact silty clay material that is very slowly pervious to moisture and breaks into medium to large subangular aggregates. These aggregates show a tendency toward vertical columnar structure. At a depth of about 48 inches gray, yellow, and brown mottled silty clay loam is reached.

Bartle silt loam requires artificial drainage for the successful production of all farm crops. Crops grown include corn, wheat, soybeans, and hay; but because of imperfect drainage the soil is so cold and wet in spring that seeding is often delayed and yields are decreased. Soybeans appear to be better suited than corn or wheat to the wet conditions of this soil, and in 1936 a large proportion of the cultivated areas was used for this crop. Corn yields from 5 to 30 bushels an acre, depending on the seasonal conditions and state of cultivation of the soil. Timothy is preferred to clover as a hay crop because of the strong acidity of the soil and the injury to clovers from heaving. About 30 percent of the total area of Bartle silt loam is cultivated, and the rest is either idle or used for timber.

Peoga silt loam.—This soil occupies level areas and is the most poorly drained of the low-terrace soils of mixed origin. Many of the areas lie only 1 or 2 feet above the first bottoms.

To a depth of 6 inches the soil is light-gray smooth friable silt loam containing numerous small black concretions. When dry the material is very light gray. Numerous crawfish mounds or chimneys are present on the surface, and the soil is locally called crawfish land or slash land. The subsoil, which reaches to a depth of about 30 inches, is mottled gray and yellow heavy silt loam that breaks into coarse granules in the upper part and into somewhat larger subangular aggregates below. The material in this layer changes abruptly to mottled

gray and yellow compact heavy silty clay loam that is almost impervious to moisture and breaks into subangular vertical prismatic aggregates 1 or 2 inches in diameter and 2 or 3 inches in length. Below a depth of 50 inches is mottled gray and yellow stratified silt and clay. Grit and pebbles are generally absent throughout the surface soil and the subsoil.

Because of the presence of a high water table and slow surface and internal drainage, only small areas of Peoga silt loam were being cultivated in 1936. Shallow open ditches or dead furrows placed about 2 rods apart help to drain away the surface water so as to allow cultivation. Corn and soybeans are grown, but yields are usually low. The greater part of this soil either is in timber or has formerly been cultivated and at present is idle, supporting a growth of weeds, briers, and poverty oatgrass.

As mapped, Peoga silt loam includes about 20 acres of dark-colored poorly drained soil much like the Montgomery silty clay loam of other areas in southern Indiana. This included soil is about a quarter of a mile west of Needmore. The 7-inch surface layer of this inclusion is very dark brownish-gray to gray silty clay loam in which organic matter is comparatively abundant and appears to be rather stable. The material breaks into coarse-granular aggregates. Below this is gray clay loam containing numerous irregular rust-brown streaks and spots that increase in intensity with depth. It is the darkest colored and most productive soil in the county for the growing of corn and soybeans. It is planted to corn for several consecutive years, and yields of from 40 to 70 bushels are obtained. It is not well suited for the growing of small grains because of the injury caused from lodging. The high productivity of this very small inclusion should not be confused with the much larger area of relatively unproductive typical Peoga silt loam.

ALLUVIAL SOILS

The alluvial soils developed from material washed from sandstone and shale areas and those developed from material washed from Illinoian glacial till are practically identical in Brown County. In fact, materials of both origins are represented in almost every fair-sized area of alluvial soils. Alluvial soils include members of the Pope, Philo, Stendal, and Atkins series. All are strongly acid and have light-colored surface soils, except in wooded areas where the surface 2 or 3 inches is somewhat darkened in places by the accumulation of organic material. Drainage conditions range from very rapid in Pope flaggy loam to very poor in Atkins silt loam. With few exceptions, all these soils receive deposits from the overflow of the adjacent streams. These soils are closely associated in many places, and boundaries between them in places are necessarily drawn arbitrarily.

Pope silt loam.—This is a well-drained soil occurring close to the stream channels. The surface 7 inches in cultivated areas is brown to yellowish-brown mellow silt loam with a slightly laminated structure. The organic-matter content is variable, depending on the nature of the most recent addition of alluvium and the state of cultivation. The subsoil consists of alluvial deposits of silt loam that generally

show depositional layers, or horizons, and in some places contain thin layers of sandy material. Bedrock of sandstone or shale occurs at a variable depth, generally between 4 and 5 feet.

Pope silt loam is one of the most productive soils in the county. It has excellent tilth and aeration, and it absorbs water at a rapid but not excessive rate. It is usually flooded at least once each year, each flood leaving a deposit of material that aids in maintaining fertility.

A crop rotation of corn, wheat, soybeans, and hay is followed on this soil. Corn may be expected to yield from 15 to 50 bushels an acre, with an average of about 35 bushels. Corn is often grown for 2 or more successive years without depleting the soil to a great extent, because of the replenishment of plant nutrients by overflow. The acreage used for growing corn on this soil probably is proportionately greater than on any other soil in the county. Yields of wheat are fair to good—from 6 to 22 bushels an acre—but damage from overflow waters is frequently serious. Soybeans are grown, and yields of from 1 to 3 tons of hay an acre are obtained. This crop often replaces wheat in the rotation and probably is better suited to this soil, as seeding occurs after danger of overflow is passed. In recent years lime has been applied to a large acreage of Pope silt loam, and fair to good stands of clover and alfalfa have been obtained. A small acreage along the smaller streams and drainageways is at present in pasture and timber.

Pope silt loam, high-bottom phase.—The high-bottom phase of Pope silt loam has essentially the same profile characteristics as Pope silt loam, but it occurs on slightly higher levels of the flood plains in association with Pope silt loam.

The same crops are grown on this soil as are grown on Pope silt loam. Crop yields are about the same on the two soils, except that damage by overflow waters is neither so great nor so frequent on this soil as on the other alluvial soils.

Pope loam.—In cultivated areas Pope loam consists of brown to yellowish-brown friable mellow loam to a depth of 7 inches. The organic-matter content is variable, depending on the nature of the recent alluvial deposits. Below this is brownish-yellow or yellowish-brown silt, fine sand, and clay, that show depositional layers or strata. Bedrock lies about 4 feet below the surface.

Only a few areas of Pope loam are mapped, mostly in the western part of the county along North Fork Salt Creek. About 50 percent of the total area is cultivated to corn and soybeans; the rest is in pasture or timber. Crop yields are only slightly lower than those obtained on Pope silt loam.

Pope flaggy loam.—This soil borders the smaller streams and drainageways and consists of mixed and unassorted silt, clay, and water-worn flaggy fragments of sandstone. The rock fragments average about 2 inches in length but range from about 12 inches down to very small pieces. A few small areas of soil that is rock-free to a depth of 10 to 12 inches occur within areas of this soil, but they are too small to separate on the map. At present the less flaggy areas are planted to corn or to vegetables for consumption in the home, but yields are low. This material is very rapidly drained, and in most areas rock fragments are too numerous on the surface and throughout the profile to allow adequate cultivation. Attempts have been made

in the past to cultivate a large area of this soil, but at present it supports a growth of weeds, briers, and shrubs. Many areas are in forests.

Philo silt loam.—This soil is only slightly less well drained than Pope silt loam. It lies slightly back from the stream channels. In cultivated areas the surface soil is brown to yellowish-brown mellow friable silt loam. At a depth of 12 to 14 inches this material grades into slightly heavier pale brownish-yellow silt loam, and at a depth of about 14 to 20 inches the soil is mottled with gray, yellow, and brown. This mottling increases with depth, and older water-deposited layers of silt, clay, and fine sand occur at a depth of 30 to 40 inches. In places bedrock lies 4 to 6 feet below the surface.

Philo silt loam equals Pope silt loam in agricultural value. The two soils are the best suited for agricultural use of all the soils in the county. Corn is grown extensively, and yields range from 15 to 50 bushels an acre. Philo silt loam is often planted to corn for 2 or more consecutive years without serious depletion of plant nutrients. Wheat is grown to some extent and yields from 6 to 20 bushels, but this crop may be seriously damaged early in spring from overflow waters. Soybeans produce from 1 to 3 tons of hay an acre and take the place of wheat in the crop rotation. In recent years a large quantity of ground limestone has been applied to this soil, and good stands of clover and alfalfa have been obtained.

In 1936 a small acreage was planted to tobacco, which yielded from 900 to 1,500 pounds an acre. Tomatoes are occasionally grown on this soil, with yields of 3 to 6 tons. Only small isolated areas of Philo silt loam are in forest or in permanent pasture, as the value of this soil for the production of crops is generally appreciated.

Philo loam.—Philo loam has a surface soil of brown to yellowish-brown mellow friable loam to a depth of about 7 inches, which is underlain to a depth of about 16 inches by pale-yellow to brownish-yellow silt loam. Below this material is mottled gray, yellow, and brown silt, clay, and fine sand, which in many places occurs in thin depositional layers. Bedrock lies at a depth of 4 to 6 feet.

Only a small acreage of Philo loam is mapped, mainly in the central-western part of the county. It is planted principally to corn, soybeans, and hay, and yields are slightly lower than those obtained on Philo silt loam.

Stendal silt loam.—This is an imperfectly drained soil that occurs on the first bottoms in association with the Pope and Philo soils. It is generally well back from the stream channels where surface drainage is only fair and the water table is high. The 7-inch surface layer is brownish-gray friable silt loam, underlain by mottled gray and yellow silt loam. The yellow color in many places occurs as a coating on breakage surfaces and along old root channels. Below a depth of 24 inches thin layers of clay, silt, and fine sand are reached.

Stendal silt loam is cold and wet in spring, and artificial drainage is required for successful cultivation. Either open ditches or tile are used for drainage. Open ditches are less expensive and are most commonly used. Because of the position of the land, outlets to stream channels are rather difficult to establish. Owing to the cold, damp condition of the soil, seeding is often delayed in spring, and in seasons of excessive rainfall serious damage may result from an excess

of moisture. Corn is grown to some extent, and yields of 10 to 30 bushels are obtained. Very little wheat or rye is grown on this soil, because of the injury from a high water table and from heaving. Soybeans appear to be better suited to this soil than are other crops, and in recent years a large acreage has been grown. Clovers grown on Stendal silt loam are often drowned out or are seriously injured by heaving. Areas not cropped are in timber or support a growth of weeds, poverty oatgrass, and briars.

Atkins silt loam.—This is the most poorly drained of the alluvial soils. It occupies the lower swags and depressions well back from the stream channel. In periods of excessive moisture, water stands on areas of this soil and drains away very slowly.

The surface soil of Atkins silt loam is gray friable silt loam containing irregular yellow streaks or stains throughout. When dry the surface is very light gray. Numerous crawfish mounds are present on the surface. Below a depth of 4 inches is gray silt loam containing numerous small black concretions and blotches of yellow and iron-rust brown material. Old depositional layers of silt and clay generally are distinguishable.

An attempt has been made to cultivate small areas of this soil, but in 1936 all areas were either in timber or idle. The predominant tree growth is oak, elm, sycamore, and swamp ash. Idle areas support a growth of various weeds, briers, sumac, and sassafras.

PRODUCTIVITY RATINGS

Table 4 lists the soils of Brown County in the approximate order of their estimated general productivity under the prevailing practices of better soil management with the most productive soils at the head of the table.

The rating compares the productivity of each of the soils for each crop with a standard of 100. This standard index represents the approximate average yield obtained without the use of amendments on the more extensive and better soil types of the regions of the United States in which the crop is most widely grown. An index of 50 indicates that the soil is about half as productive for the specified crop as is the soil with the standard index. The standard yield for each crop shown in table 4 is given at the head of each respective column. Soils given amendments such as lime and commercial fertilizers, or special practices, such as irrigation, and unusually productive soils of small extent, may have productivity indexes of more than 100 for some crops.

The indexes in table 4 are estimates of yields that are based primarily on observations in the field and on interviews with farmers, members of the staffs of the State Agricultural Experiment Station and the College of Agriculture, and others who have had experience in the agriculture of the county and State. As such, they are presented only as estimates of the average production over a period of years. It is realized that these estimates may not apply directly to specific tracts of land for any particular year, inasmuch as the soils as shown on the map vary somewhat, management practices differ slightly from farm to farm, and climatic conditions fluctuate from year to year.

The indexes in column A under each crop heading are estimates of the yields to be expected without the use of commercial fertilizer, lime,

TABLE 4.—*Estimated productivity ratings of the soils of Brown Co*

Soil [1]	Crop productivity index [2] for—											
	Corn (open-pollinated) [3] (100=50 bu.)		Wheat (100=25 bu.)		Oats (100=50 bu.)		Rye (100=25 bu.)		Soybeans (100=25 bu.)		Alfalfa (100=4 tons)	
	A	B	A	B	A	B	A	B	A	B	A	B
Russell silt loam	65	80	50	70	50	65	50	65	65	75	20	60
Fincastle silt loam	60	80	40	70	50	65	50	65	60	70	15	60
Pope silt loam, high-bottom phase	70	80	50	70	50	65	50	65	70	75	15	50
Pope silt loam	70	80	50	65	50	60	50	60	70	75	10	45
Philo silt loam	70	80	50	70	50	60	50	60	70	75	10	45
Pope loam	65	80	45	55	45	55	45	55	65	70	10	40
Philo loam	65	80	45	55	45	55	45	55	65	70	10	40
Gibson silt loam	50	60	40	55	40	55	40	55	50	60	------	------
Tilsit silt loam	50	60	40	55	40	55	40	55	50	60	------	------
Cincinnati silt loam	50	60	40	55	40	55	40	55	50	60	------	------
Zanesville silt loam	40	55	40	55	40	55	40	55	40	50	------	------
Avonburg silt loam	40	60	20	50	15	35	20	50	40	60	------	------
Haubstadt silt loam	40	50	30	40	30	40	30	40	40	50	------	------
Pekin silt loam	40	50	30	40	30	40	30	40	40	50	------	------
Elkinsville silt loam	40	50	30	40	30	40	30	40	40	50	------	------
Otwell silt loam	40	50	30	40	30	40	30	40	40	50	------	------
Wellston silt loam	30	40	20	30	20	30	20	30	30	35	------	------
Stendal silt loam	30	40	10	25	10	25	10	25	30	40	------	------
Bartle silt loam	30	40	10	25	10	25	10	25	30	40	------	------
Clermont silt loam	20	60	5	20	5	15	5	20	10	60	------	------
Cincinnati silt loam, shallow phase	30	40	15	20	15	20	15	20	20	25	------	------
Atkins silt loam	15	35	5	15	5	15	5	15	10	30	------	------
Peoga silt loam [4]	15	30	5	15	5	15	5	15	10	25	------	------

Parke silt loam	10	20	5	10	5	10	5	10	10	20		
Pope flaggy loam	10	15	5	10	5	10	5	10	5	10		
Cincinnati silt loam, slope phase	10	15	10	15					10	15		
Otwell silt loam, slope phase	10	15							10	15		
Wellston silt loam, slope phase	10	15							10	15		
Muskingum silt loam, colluvial phase									10	10		
Wellston-Muskingum complex												
Cincinnati silt loam, eroded phase												
Otwell silt loam, eroded phase												
Zanesville silt loam, eroded phase												
Muskingum stony silt loam												
Cincinnati silt loam, gullied phase												

[1] The soils are listed in the estimated approximate order of their general productivity under prevailing practices of good farm management.

[2] The soils are given indexes that indicate the approximate average production of each crop in percentage of the standard of reference. The standard represents the approximate yield obtained without the use of amendments on the more extensive and better soil types of those regions of the United States in which the crop is most widely grown. The indexes are based upon estimates of yields, as specific yield data are very limited. The indexes in the column headed A under each crop refer to yields obtained under a comparatively low level of management that does not include the use of commercial fertilizers, lime, manure, or artificial drainage; the indexes in column B refer to yields obtained under, management that includes the use of manure, commercial fertilizers, lime, legumes in the rotation, artificial drainage (where needed), and erosion-control practices (where needed). Details of the practices under B vary, of course, with the requirements of individual crops and soils. Blank spaces indicate that the crop is not commonly grown.

[3] No yields are reported for hybri
in Brown County at the time of su
crease of 5 to 10 percent above those

[4] Yields are better on small areas
been included with Peoga silt loam

or manure, or of artificial drainage on the poorly drained soils. In other words, the yields are those estimated for a so-called low level of management. The indexes in column B are estimates of the yields that are obtained under the common better farming practices, including the use of fertilizer and manure, legumes in the rotation, and, where needed, artificial drainage and simple erosion-control practices. Wheat commonly receives from 100 to 200 pounds of 2–12–6 or similar fertilizer to the acre. Two to 4 tons of lime is commonly applied, depending on the specific requirements of the soils in question, for the establishment of legumes in the rotation.

The principal factors affecting the productivity of land are climate, soil (including the many physical, chemical, and biological characteristics), slope, drainage, and management (including the use of amendments). No one of these factors operates separately from the others, although some one may dominate. In fact, the factors listed may be grouped simply as the soil factor and the management factor, since slope, drainage, and most of the aspects of climate may be considered as characteristics of a given soil type, and because the soil type occupies specific geographical areas characterized by a given range of slope and climatic conditions. Crop yields over a long period of years furnish the best available summation of the associated factors and therefore are used where available.

The arrangement of the soils on the basis of their general productivity was based primarily on the indexes assigned to column B, and more weight was given to the indexes of the major crops than to those of the minor crops. No precise mathematical procedures were followed in setting up this order, since it is difficult to measure mathematically either the exact significance of a crop in the agriculture of an area or the importance or suitability of certain soils for particular crops. Too much significance, therefore, should not be given to the exact order in which the soils are listed, although the arrangement does give information as to the comparative general productivity, as suggested by the statements in the right-hand column headed "Remarks."

Productivity tables do not present the relative roles that soil types, because of their extent and the pattern of their distribution, play in the agriculture of the county. The tables show the relative productivity of individual soils. They cannot picture in a given county the total quantitative production of crops by soil areas without the additional knowledge of the acreage of the individual soil types planted to each of the specified crops.

Economic considerations have played no part in determining the crop productivity indexes. They cannot be interpreted, therefore, into land values except in a very general way. Distance to market, relative prices of farm products, and other factors influence the value of land. It is important to realize that productivity, as measured by yields, is not the only consideration that determines the relative worth of a soil for growing crops. The ease or difficulty of tillage and the ease or difficulty with which productivity is maintained are examples of other considerations than productivity that influence the general desirability of a soil for agricultural use. In turn, steepness of slope, presence or absence of stone, the resistance to tillage offered by the soil because of its consistence or structure, and the size and shape of areas are characteristics that influence the relative ease with which soils can be tilled. Likewise, inherent fertility and susceptibility to

erosion are characteristics that influence the ease in maintaining soil productivity at a given level. Productivity, as measured by yields, is influenced in some degree by all of these factors and by others such as moisture-holding capacity of the soil and its permeability to roots and water, and so they are not factors to be considered entirely separate from productivity; but on the other hand, schemes of land classification to designate the relative suitability of land for agricultural use generally give some separate recognition to them.

MORPHOLOGY AND GENESIS OF SOILS

Soil is the product of the forces of weathering and development acting on the parent soil materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point depend on (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and has existed since accumulation, (3) the plant and animal life in and on the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of development have acted on the material. External climate, although important in its effects on soil development, is less so than internal soil climate, which depends not only on temperature, rainfall, and humidity, but on the physical characteristics of the soil or soil material and on the relief, which, in turn, strongly influences drainage, aeration, runoff, erosion, and exposure to sun and wind.

Brown County lies within the region of Gray-Brown Podzolic soils. The soils are light-colored and originally had a heavy cover of deciduous trees of the oak-hickory association. The climate of the region is of the humid temperate continental type. The relief is that of a well-dissected former plain, consisting of narrow ridges, steep-sided slopes, and relatively narrow stream bottoms.

The outstanding factors of environment influencing soil development in this county are (1) a rainfall heavy enough to wet the soil to an indefinite depth, so that a moist condition, except in very short periods, is maintained throughout the soil and well into the parent material; (2) a temperate climate; and (3) a deciduous forest cover under which the soils have developed.

The parent materials consist of sandstone, siltstone, shale, and glacial till deposited by the Illinoian and early Wisconsin glaciers, and alluvium of various ages. The glacial material consists of a mixture of silt, clay, sand, rock fragments, and rock flour, and where unleached it is calcareous.

On the basis of parent material and method of occurrence, the soils of Brown County are placed in four groups: (1) Soils developed from residual materials; (2) soils developed from glacial till; (3) soils developed from stream-terrace deposits; and (4) alluvial soils.

The residual soil materials of this county are the products of the decomposition of interbedded sandstone, siltstone, and shale of the Borden group of geological formation. These soils are members of the Zanesville, Tilsit, Wellston, and Muskingum series.

The Zanesville soils represent the typical well-drained Gray-Brown Podzolic soils of the region where soils are developed from sandstone, siltstone, and shale. They are light in color and have an upper eluviated layer that has lost material by chemical and physical action and

a lower illuviated layer that has gained in finer textured materials and compounds of iron and aluminum. These characteristics are the result of the process of soil development.

The following is a typical profile description of Zanesville silt loam, taken in a pastured area in the SE¼ sec. 20, T. 8 N., R. 3 E.:

(1) 0 to 1 inch, dark grayish-brown mellow silt loam containing numerous roots and enough organic matter to darken it. The reaction is medium acid.[8]

(2) 1 to 8 inches, grayish-brown loose friable silt loam containing numerous fine roots. The material has a fine-granular structure. The reaction is medium acid.

(3) 8 to 18 inches, yellowish-brown silty clay loam, breaking into coarse-granular to nutlike aggregates. Few roots are present, and worms are active. The reaction is the same as in the layer above.

(4) 18 to 27 inches, brownish-yellow to yellowish-brown heavy silty clay loam that breaks into coarse nutlike aggregates from ½ to 1 inch in diameter. This horizon is lighter in color than the above horizon, and a coating of light-gray material occurs on the cleavage surfaces in the lower part. The reaction is very strongly acid.

(5) 27 to 29 inches, yellow, brown, and gray silty clay loam. A thin coating of gray material occurs on the cleavage faces and along old root and worm channels, giving a mottled appearance to the material in place; but this disappears when crushed. This horizon breaks into nutlike aggregates about ⅜ inch in diameter and is somewhat compact in place.

(6) 29 to 42 inches, mottled gray, yellow, and brown heavy compact clay loam or silty clay loam. This is the heaviest and most compact layer in the profile. It breaks out into medium-sized roughly prismatic aggregates having an ill-defined columnar structure. These break down under pressure into small nutlike aggregates about ⅜ inch in diameter. The reaction is very strongly acid.

(7) 42 to 44 inches, brownish-yellow silt loam having very little gray mottling. This is an abrupt change from the above horizon in texture, color, and diameter. The reaction is very strongly acid.

(8) 44 to 50 inches, brownish-yellow silty clay loam partly weathered material, containing numerous rock fragments. The reaction is very strongly acid.

(9) 50 inches+, unweathered bedrock of sandstone, siltstone, and shale.

Some areas of the Zanesville soils vary from the foregoing description in the thickness of the various horizons and in depth to bedrock.

Tilsit silt loam differs from Zanesville silt loam in the subsoil horizons. The upper part of the subsoil is pale brownish yellow, grading downward into mottled gray, yellow, and brown compact "pan" at a depth of 15 inches. It occurs on the wider ridge top and local flats, where surface and internal drainage are not so thorough as they are in Zanesville silt loam.

The Wellston soils occur on such narrow ridge tops that comparatively rapid geological erosion has prevented the development of Zanesville silt loam. The surface and upper subsoil horizons are similar to those of the Zanesville, but the heavy compact horizons are absent, and bedrock lies at an average depth of about 30 inches. The Wellston soils also occupy narrow bands between the Zanesville and Muskingum soils.

The Muskingum soils have grayish-brown to brownish-gray surface soil and brownish-gray subsoil, which rests on partly weathered parent material at a depth of about 15 inches. Fragments of sandstone and shale are numerous on the surface and throughout the soil mass. This is an A–C soil, having no heavy-textured subsoil, or B horizon.

[8] pH determinations made in the field by the use of colorimetric indicators.

between the surface soil and the parent rock. Practically all of the Muskingum soils occur on slopes of more than 15 percent.

The second major group of soils—those developed on glacial till—form two subgroups: (1) Those developed on till deposited by the Illinoian glaciation and subsequently leached to a depth of about 10 feet; and (2) those developed on till deposited by the early Wisconsin ice sheet and subsequently leached to a depth of about 5 feet.

The soils forming the first subgroup, or those developed on till deposited by the Illinoian ice sheet, include members of the Cincinnati, Gibson, Avonburg, Clermont, and Parke series. The character of the parent material of these soils, with the exception of Parke silt loam, is similar and has had little to do with the differences among them.

Instead, the chief variable in the formation of these soils is the slope of the land, which controls surface drainage and, as a result, the degree of oxidation of the various horizons in the profile. They differ from the soils of the second subgroup in (1) depth to which calcium carbonate has been leached—an average of about 10 feet, or about twice the depth in the soils developed on early Wisconsin till; (2) the strongly acid reaction of the surface soil and subsoil; and (3) the smoothness of the material and thorough weathering of the rock fragments. The Illinoian glacial till consists of a mixture of silt, clay, rock fragments, and rock flour and is very similar to the early Wisconsin till.

Cincinnati silt loam is a typical Gray-Brown Podzolic soil developed from Illinoian till. It is light-colored and has an eluviated surface A horizon that has lost material by chemical and physical action and a heavier illuviated B horizon that has gained in finer textured materials. The heavy compact "claypan" horizon has elsewhere [9] been called the X horizon, and the silty layer or layers occurring immediately below the X is called the Y horizon. In Cincinnati silt loam the X horizon is not strongly developed and in many places is absent. It is more typical of Gibson, Avonburg, and Clermont soils, which belong to the Planosol group.[10] The Y horizon is leached and strongly weathered parent material.

A profile description of typical Cincinnati silt loam in a wooded area 2 miles north of Bean Blossom is as follows:

A_0. ½ to 0 inch, accumulated layer of leaves, moss, twigs, and partly decayed vegetal material. The reaction is neutral.

A_1. 0 to 3 inches, dark grayish-brown to brownish-gray smooth friable silt loam having a phylliform structure. Enough organic matter is present to darken the material somewhat. Feeder tree roots are numerous, and worms are very active. The reaction is slightly acid.

A_2. 3 to 8 inches, grayish-brown to brown friable silt loam, showing some evidence of phylliform structure, and breaking into medium-sized granules and flakes. Many worm casts of dark-colored silty material are present, and roots are less numerous than in the horizon above. The reaction is medium acid.

A_3. 8 to 12 inches, light grayish-brown smooth friable silt loam that is slightly heavier textured than the horizon above. The material breaks into small subangular fragments, which, in turn, may be broken with ease into fine granules. Worm casts are numerous. The reaction is medium acid.

B_1. 12 to 21 inches, brownish-yellow heavy silt loam, which breaks into small matlike aggregates from ⅜ to ¾ inch in diameter. Few roots

[9] MILLER, JOHN T., HIGBEE, HOWARD WM., WIANCKO, A. T., and WAGGONER, M. E. SOIL SURVEY OF WASHINGTON COUNTY, INDIANA. U. S. Dept. Agr., Bur. Chem. and Soils, Ser. 1932, No. 36, 65 pp., illus.

[10] For definition see: A GLOSSARY OF SPECIAL TERMS USED IN THE SOILS YEARBOOK. U. S. Dept. Agr. Yearbook 1938 (Soils and Men): 1174. 1938.

are present, and worm activity is less conspicuous than in the horizons above. The reaction is strongly acid.

B_2. 21 to 31 inches, brownish-yellow silty clay loam that breaks into subangular nutlike aggregates about ¾ inch in diameter. These aggregates may be broken without much effort into coarse-granular aggregates. A thin coating of gray colloidal clay material is on the cleavage faces, producing a somewhat mottled appearance when the material is in place, but this color disappears when the material is crushed. A few small pebbles and rock fragments are present, largely composed of quartz. The reaction is strongly acid.

X. 31 to 36 inches, dark brownish-yellow fairly heavy silty clay loam. The material breaks into subangular aggregates about ¾ by 2 inches and shows some indication of prismatic structure. A thin coating of gray colloidal clay is present on the cleavage faces. This is a weakly developed claypan that is stratigraphically continuous with the more strongly developed claypans of the adjacent Gibson and Avonburg soils. This horizon is absent in many areas of Cincinnati silt loam. The reaction is strongly acid.

Y. 36 to 116 inches, mottled or blotched yellow, gray, and brown heavy silt loam, containing some small rock fragments. This material breaks into angular aggregates having a horizontal length three or four times the vertical dimension. The lower part of the horizon is streaked with rusty-brown iron compounds. The reaction is medium acid, becoming slightly acid or neutral below.

C. 116 inches +, gray and yellow calcareous glacial till, composed of silt, clay, rock fragments, and rock flour.

In places the Cincinnati soils vary somewhat from the foregoing description in the thickness of the several horizons and in the depth to calcareous till.

Gibson silt loam is slightly less well drained than the Cincinnati soils and occurs on the broader gently undulating ridge tops back from the slopes. It differs from Cincinnati silt loam in having a pale-yellow upper B horizon to a depth of about 15 inches, where mottled gray and yellow material is reached, and in having a compact X horizon that is generally heavier and thicker, averaging about 10 inches in thickness. Calcareous till occurs at about the same depth as in the Cincinnati soils.

Avonburg silt loam is an imperfectly drained soil occupying the flat to gently undulating uplands where surface drainage is intermediate between that of the Gibson and that of the Clermont soils. The characteristics of the soil are represented by the following description of a profile examined in a hayfield where the cover was a poor stand of timothy containing poverty grass, various weeds, and a scattering of sumac and sassafras.

A_1. 0 to 7 inches, dark brownish-gray friable silt loam having a medium-granular structure. When dry the surface is gray. Roots are numerous. The reaction is strongly acid.

A_2. 7 to 12 inches, light grayish-yellow or pale-yellow friable heavy silt loam, conspicuously mottled with gray blotches and spots, and containing some small rounded iron concretions. The material breaks into coarse-granular aggregates. Roots are not so numerous as in the horizon above, and there is little worm activity. The reaction is strongly acid.

B_1. 12 to 17 inches, mottled yellow, gray, and brown moderately friable heavy silt loam that breaks into subangular aggregates from ⅛ to ½ inch in diameter. Numerous small soft black iron concretions are present. The reaction is strongly acid.

B_2. 17 to 33 inches, mottled yellow, gray, and brown heavy silt loam or light silty clay loam that breaks into subangular aggregates from ¼ to ¾ inch in diameter. The mottling is more intense and the soft iron concretions are more numerous than in the above horizon. The reaction is strongly acid.

X. 33 to 50 inches, mottled gray and yellow silty clay. The change from the above horizon is rather abrupt, and the material is very compact in place. It breaks into prismatic aggregates, about ¾ by 2 inches. The cleavage faces are coated with gray colloidal clay material, and the tops of some of the prisms are rounded. This horizon is almost impervious to moisture and is probably the result of a fluctuating ground-water level. The reaction is very strongly acid.

Y. 50 to 119 inches, mottled gray and yellow silty material with numerous iron-rust brown stains or blotches, which become more intensified with depth. This horizon contains some small rock fragments, mostly quartz. The reaction is strongly acid in the upper part but becomes almost neutral in the lower part.

C. 119 inches +, gray and yellow calcareous till, composed of a mixture of silt, clay, rock flour, and rock fragments.

Clermont silt loam occurs on the flat areas in the uplands and is the most slowly drained soil in this catena.

The surface 6 inches is light-gray smooth friable silt loam. Numerous crawfish mounds are present on the surface, and this soil is known locally as crawfish land or slash land. Irregular streaks or stains of yellow are present, as are numerous soft small rounded brown and black iron concretions. When it is dry, the surface soil is ash gray. The rest of the profile is very similar to that of Avonburg silt loam, except that horizon A_2 is light gray with little or no yellow, and the heavy compact horizon is much thicker.

The soils developed on till deposited by the early Wisconsin ice sheet include Russell silt loam and Fincastle silt loam. They are both light-colored and are underlain at a depth of 50 to 60 inches by calcareous till.

Russell silt loam is a well-drained soil of the gently rolling to strongly rolling uplands. A typical profile of this soil under a forest cover of deciduous trees of the oak-hickory association is as follows:

A_0. ½ inch (about) to 0, accumulated layer of partly decomposed leaves, twigs, moss, and other forest litter. The reaction is neutral.

A_1. 0 to 3 inches, dark grayish-brown friable silt loam, having a phylliform structure and composed of fine flaky aggregates. Feeder roots of trees are numerous, and there is much worm activity. The reaction is slightly acid.

A_2. 3 to 11 inches, grayish-brown to brown smooth friable silt loam, having a coarse-granular structure. Roots are less numerous than in the above horizon, and there is much worm activity. The worm casts are composed of gray silty material. The reaction is medium acid.

B_1. 11 to 17 inches, yellowish-brown to brownish-yellow heavy silt loam or silty clay loam. The material breaks into small subangular aggregates, which, in turn, are easily broken down into minute granules. It is free of gritty material and rock fragments. The reaction is medium acid.

B_2. 17 to 33 inches, dark brownish-yellow heavy silty clay loam that breaks into medium-sized subangular aggregates. A thin gray coating occurs on the cleavage faces, giving a somewhat mottled appearance to the material in place, but this disappears when the material is crushed. It is plastic when wet and hard when dry. The reaction is medium acid.

B_3. 33 to 51 inches, brownish-yellow heavy silty clay loam containing numerous iron-rust brown spots and streaks and angular rock fragments. The material breaks into irregular-sized lumps that may be broken without great difficulty into small subangular aggregates. The reaction is slightly acid.

C_1. 51 inches +, gray and yellow calcareous till composed of a mixture of silt, clay, and rock fragments.

Fincastle silt loam is an imperfectly drained soil of the smooth areas in the uplands, generally back from the slopes and drainageways. The surface is brownish-gray friable silt loam, underlain at a depth of

8 inches by mottled silt loam, which becomes heavier textured with depth. At a depth of about 18 inches is mottled gray and yellow compact clay loam, breaking into irregular-sized subangular aggregates. This horizon is only slowly pervious to moisture. Below it is mottled gray and yellow silty clay loam similar in structure to the layer above, but the texture is somewhat lighter and the lower part contains stains and blotches of iron-rust brown. Calcareous till lies at a depth of about 52 inches.

Soils developed from stream-terrace deposits are derived (1) from stratified glacial-fluvial outwash material composed of sand, silt, and clay; and (2) from stratified silts and clays of mixed origin.

The soils of the first subgroup, derived from glacial-fluvial outwash material, occur principally adjacent to the larger streams in the county and generally lie several feet higher in elevation than those forming the second group. They occur as high as 30 feet above the alluvial plains, in many places in small isolated areas. Included in this group are Otwell and Haubstadt silt loams. Soils of the higher terraces generally are more completely developed than those of the lower terraces.

Otwell silt loam is a well-drained soil occurring in small areas having good surface drainage. A profile description of this soil taken half a mile west of Helmsburg, along the State highway, under a good cover of oak and hickory trees, is as follows:

A_0. ½ inch (about) to 0, partly decayed leaves, twigs, leafmold, and other forest litter. The reaction is neutral.

A_1. 0 to 5 inches, grayish-brown smooth friable silt loam. Some organic matter is present and is mixed with the mineral material. The structure is thin platy to phylliform, and the material breaks into fine flaky aggregates. Numerous roots are present, and worms are active. The reaction is strongly acid.

A_2. 5 to 10 inches, dull yellowish-brown friable silt loam that is slightly heavier textured than the horizon above. The material still shows some of the original lamination. Few roots are present, and worms are active. The reaction is strongly acid.

B_1. 10 to 15 inches, brownish-yellow silty clay loam having a coarse-granular to nutlike structure. The aggregates are about ⅜ inch in diameter. The reaction is strongly to very strongly acid.

B_2. 15 to 32 inches, yellow smooth silty clay loam that breaks into nutlike aggregates about ⅜ to ¾ inch in diameter. A few gray seams occur in the lower part of the horizon. The reaction is strongly to medium acid.

X. 32 to 43 inches, dark-yellow to brownish-yellow heavy compact silty clay having an ill-defined columnar structure. The cleavage faces are thinly coated with gray colloidal clay material, giving a variegated or mottled effect to the material; but this effect disappears when the material is crushed. The reaction is medium acid.

Y_1. 43 to 60 inches, yellow silty clay loam mottled with gray and olive, breaking into irregular-sized fragments, which are easily crushed into medium-sized granules. The reaction is medium acid.

Y_2. 60 to 84 inches, yellow and gray stratified layers of loam and very fine sandy loam. The various layers are old depositional layers, each being predominantly yellow or gray without regard to texture. The material breaks into irregular-sized and irregular-shaped pieces. The reaction is slightly to medium acid.

C_1. 84 to 120 inches, mottled gray and yellow stratified layers of sand, silt, and clay, with dark iron-rust brown blotches and stains occurring irregularly throughout the material. The thickness of the layers ranges from ½ inch to 8 inches. The reaction is slightly to medium acid.

C_2. 120 to 132 inches +, mottled bright yellow and gray very fine sandy loam. The reaction is slightly acid.

In places Otwell silt loam varies from the above description in the thickness of the various horizons.

Haubstadt silt loam is slightly less well drained than Otwell silt loam, occurring in smooth to nearly level areas. The profile differs from that of Otwell silt loam in having a pale-yellow B horizon to a depth of 15 inches, and a mottled gray and yellow B_2 horizon; the rest of the profile is similar to that of Otwell silt loam.

The soils of the terraces of the second subgroup, composed of silts and clays of mixed origin, are members of the Elkinsville, Pekin, Bartle, and Peoga series.

Elkinsville silt loam is a well-drained soil of gently rolling to sloping areas. It occurs in small isolated areas, and the total area in the county is small. The surface 7 inches is brown to grayish-brown smooth friable silt loam having a fine granular structure. The B_1 horizon is yellowish-brown smooth silt loam that breaks into coarse-granular aggregates. This is underlain at a depth of about 14 inches by brownish-yellow to yellow heavy silt loam that breaks into nutlike aggregates about three-eighths of an inch in diameter and is free of grit or pebbles. At a depth of about 30 inches a heavy, somewhat indurated horizon about 6 inches thick is present in places. This material breaks into subangular aggregates about three-fourths of an inch in diameter having a gray colloidal coating on the cleavage faces. Below this is yellow smooth silty clay or silty clay loam, which, with depth, becomes slightly mottled and streaked with gray silt. Remnants of stratification may be observed throughout the profile, and grit and pebbles are absent. All horizons are strongly acid.

Pekin silt loam is slightly less well drained than Elkinsville silt loam, with which it is associated, and has a smoother surface. The profile differs from that of the Elkinsville soil in having a pale-yellow B_1 horizon to a depth of 16 inches, a mottled gray and yellow B_2 horizon, and a thicker heavy silty clay horizon.

Bartle silt loam is an imperfectly drained soil that occupies the nearly level areas on the lower terraces and is generally associated with the more poorly drained Peoga silt loam. The characteristics of Bartle silt loam are represented by the following description of a profile examined in the SW¼ sec. 19, T. 9 N., R. 3 E., under a cover of timothy and bluegrass pasture:

A_1. 0 to 8 inches, brownish-gray smooth friable silt loam showing a faint platy structure. The material breaks into fine flaky aggregates. The organic-matter content is low, and roots are numerous. The reaction is medium acid.

A_2. 8 to 12 inches, grayish-yellow smooth silt loam containing a few iron-rust brown streaks and stains and slightly mottled with gray in the lower part. A faint laminated structure is noticeable. The reaction is strongly acid.

B_1. 12 to 27 inches, definitely mottled gray, yellow, and brown heavy silt loam that breaks into subangular aggregates having a diameter of ¼ to 1¼ inches. These may be broken without much pressure into coarse granules. The reaction is strongly acid.

X. 27 to 49 inches, mottled gray and yellow heavy compact silty clay, with a faint columnar structure, that breaks into angular blocky aggregates, When dry this horizon becomes very hard, compact, and practically impervious to moisture. Faint laminations of old depositional layers persist. The reaction is strongly acid.

Y. 49 to 65 inches +, mottled gray and yellow heavy silt loam containing numerous iron-rust brown stains, which appear as a coating on cracks and cleavage faces. The material breaks into irregular-sized and irregular-shaped subangular pieces, which, in turn, may be broken with ease into small nutlike aggregates. Pebbles and grit are absent in this horizon, as well as in the above horizons. The reaction is strongly acid.

In places the profile of Bartle silt loam varies from the foregoing description in the thickness of the several horizons.

Peoga silt loam is the most poorly drained soil of this group. It occupies flat areas on low terraces generally 1 or 2 feet above the alluvial soils.

The surface 6 inches is light-gray smooth friable silt loam containing faint yellow streaks and mottlings and some iron concretions. When the soil is dry the surface appears very light gray. The rest of the profile is similar to that of the Bartle soils except that iron concretions occur in the B_1 horizon and the heavy compact horizon is much thicker. The reaction of all horizons is strongly acid.

The characteristics of the alluvial soils washed from sandstone, siltstone, and shale are very similar to those washed from Illinoian glacial till, and no distinction was made on the map. In fact, the alluvial soils represent a mixture of wash from all the uplands. Included in this group are the Pope, Philo, Stendal, and Atkins soils.

The Pope soils are well drained and generally occur close to the stream channels. In a field in NW¼ sec. 27, T. 9 N., R. 3 E., a typical area of Pope silt loam shows the following profile:

(1) 0 to 8 inches, yellowish-brown to brown mellow friable silt loam having a faint laminated structure. The material breaks into fine granules. The organic-matter content is low. The reaction is medium acid.

(2) 8 to 16 inches, brown heavy silt loam that breaks into subangular aggregates about 4 by 4 by ½ inches in size. These crumble easily into coarse granules. Faint laminations are present. The reaction is strongly acid.

(3) 16 to 40 inches +, continuation of the above material with slight variations in color and a few pockets or layers of lighter textured material. The reaction is medium acid.

The Pope soils vary from this description in the texture and thickness of the several horizons. As this soil is an accumulation of successive layers of material deposited by stream action, variations in the profile are common.

The Philo soils generally occur slightly back from the main stream channels and are slightly less well drained than the Pope soils. The surface 8 inches of Philo silt loam is yellowish-brown or brown friable silt loam with a single-grained to fine-granular structure. Below this, pale-yellow friable slightly heavier textured silt loam extends to a depth of about 16 inches. This is underlain by mottled gray, yellow, and brown heavy silt loam showing some laminations and a few layers of lighter textured material.

Stendal silt loam is an imperfectly drained soil, occurring well back from the stream channels and in slight depressions on the alluvial plains. The following description of a profile taken in a field in the SE¼ sec. 11, T. 8 N., R. 1. E., is typical of Stendal silt loam.

(1) 0 to 7 inches, brownish-gray smooth friable silt loam with a fine-granular structure. The reaction is medium acid.

(2) 7 to 40 inches +, mottled gray, yellow, and brown heavy laminated silt loam. Gray predominates, and the yellow and brown colors occur mainly as a coating on breakage faces and in old root channels. Soft brown iron concretions are present. The reaction is strongly acid.

Atkins silt loam is more poorly drained than any other alluvial soil in the county. The 6-inch surface layer is light-gray to gray friable

silt loam, with streaks and stains of yellow. This is underlain by predominantly gray heavier textured silt loam mottled with yellow. Iron concretions are numerous on the surface and throughout the soil mass. Numerous crawfish mounds are scattered over the surface. The reaction is strongly acid.

A small area, about 20 acres in extent, of Montgomery silty clay loam occurs about a quarter of a mile west of Needmore. On the soil map this small area is included with Peoga silt loam. The topography is that of a flat, low terrace or high bottom. To a depth of 7 inches the soil consists of very dark brownish-gray clay loam. The organic-matter content is relatively high and appears to be stable. The material breaks into large blocky pieces, which may be broken down into coarse-granular particles. This is underlain by gray clay loam containing irregular streaks and blotches of iron-rust brown.

MANAGEMENT OF THE SOILS OF BROWN COUNTY

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The farmer should know his soil and have a sound basis for every step in its treatment. Building up the productivity of a soil to a high level, in a profitable way, and then keeping it up, is an achievement toward which the successful farmer strives. As in any other enterprise, every process must be understood and regulated in order to be uniformly successful, and a knowledge of the soil is highly important. Different soils present different problems as to treatment, and these must be studied and understood in order that crops may be produced in the most satisfactory and profitable way.

The purpose of the following discussion is to call attention to the deficiencies of the several soils of Brown County and to outline in a general way the treatments most needed and most likely to yield satisfactory results. No system of soil management can be satisfactory unless in the long run it produces profitable returns. Some soil treatments and methods of management may be profitable for a time but ruinous in the end. One-sided or unbalanced soil treatments have been altogether too common in the history of farming in the United States. A proper system of treatment is necessary in making a soil profitably productive.

PLANT NUTRIENTS IN BROWN COUNTY SOILS

Table 5 shows the approximate total content of nitrogen, phosphorus, and potassium and the weak-acid-soluble or available phosphorus and potassium in the different soils in Brown County, expressed in pounds of elements in the 6- to 7-inch plowed surface soil of an acre, estimated at 2 million pounds.

The total plant-nutrient content is more indicative of the origin and age of a soil than of its fertility. This is particularly true of potassium. The amount of total potassium in a soil is seldom indicative of its need of potash. Some Indiana soils that have more than 30,000 pounds of total potassium to the acre in the 6-inch surface layer fail to produce corn satisfactorily without potash fertilization, because so little of the potassium they contain is available.

TABLE 5.—*Approximate quantities of nitrogen, phosphorus, and potassium per acre of surface soil (6 to 7 inches deep) in soils of Brown County, Ind.*

Soil type	Total nitrogen	Total phosphorus[1]	Total potassium	Weak-acid-soluble phosphorus[2]	Weak-acid soluble potassium[2]
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Zanesville silt loam	2,000	650	30,400	10	175
Wellston silt loam	2,000	650	34,300	25	185
Muskingum silt loam, colluvial phase	1,800	520	22,200	10	175
Tilsit silt loam	2,200	590	28,600	15	200
Parke silt loam	2,200	450	33,500	10	145
Cincinnati silt loam	2,200	570	29,100	10	175
Cincinnati silt loam, shallow phase	2,000	430	31,900	10	280
Gibson silt loam	2,000	610	28,200	20	185
Russell silt loam	2,600	600	26,000	15	175
Otwell silt loam	2,000	400	28,200	10	310
Haubstadt silt loam	2,000	440	28,200	10	170
Pekin silt loam	2,200	700	25,000	20	150
Fincastle silt loam	2,400	500	26,400	25	150
Avonburg silt loam	2,200	440	24,200	10	135
Clermont silt loam	2,000	400	22,400	15	150
Bartle silt loam	2,000	700	26,000	30	200
Peoga silt loam	2,000	740	25,500	40	210
Pope silt loam	2,000	790	28,700	40	200
Pope loam	1,600	700	26,740	20	160
Pope flaggy loam	2,600	670	34,800	10	230
Philo silt loam	1,600	700	25,700	25	245
Philo loam	1,200	590	30,900	35	210
Stendal silt loam	1,800	740	26,400	20	170
Atkins silt loam	2,000	700	27,000	20	210

[1] Soluble in strong hydrochloric acid (specific gravity 1.115).
[2] Soluble in weak nitric acid (fifth normal).

The total content of nitrogen is generally indicative of the need for nitrogen, although some soils with a low content may have a supply of available nitrogen sufficient to grow a few large crops without the addition of that element. Soils having a low total nitrogen content soon wear out, as far as that element is concerned, unless the supply is replenished by the growing and turning under of legumes or by the use of nitrogenous fertilizer. The darker soils are generally higher in organic matter. Organic matter and nitrogen are closely associated in the soils of Indiana, hence it is a fairly safe rule that the darker the soil, the richer it is in nitrogen.

The amount of phosphorus soluble in weak acid is considered by many authorities to be a still better indication of the phosphorus needs of a soil. The depth of a soil may modify its needs for phosphates. Everything else being equal, the more weak-acid-soluble phosphorus a soil contains, the less it is likely to need phosphate fertilizers. Where the weak-acid-soluble phosphorus runs less than 100 pounds to the acre, phosphates are usually needed for high crop yields.

The quantity of potassium soluble in strong or weak acid is to some extent significant. This determination, however, is not so reliable an indicator as is the determination for phosphorus, particularly with soils of high lime content. Sandy soils and muck soils are more often in need of potash than are clay and loam soils. Poorly drained soils and soils with impervious subsoils usually need potash more than well-aerated deep soils.

The use of strong or weak acid in the analysis of a soil has been criticized by some, yet such analyses can more often be correlated with crop production than can analyses of the total elements of the soil. For this reason acid solutions have been employed in these analyses.

It must be admitted, however, that no one method of soil analysis will definitely indicate the deficiencies of a soil. For this reason, these chemical data are not intended to be the sole guide in determining the needs of the soil. The depth of the soil, the physical character of the horizons of the soil profile, and the previous treatment and management of the soil are all factors of the greatest importance and should be taken into consideration. Pot tests indicate that nitrogen and phosphorus are much less available in subsurface soils and subsoils than they are in surface soils. On the other hand, potassium in the subsoil seems to be of relatively high availability. Crop growth depends largely on the amount of available plant nutrients with which the roots may come in contact. If the crop can root deeply, it may be able to make good growth on soils of relatively low analysis. If the roots are shallow, the crop may suffer from lack of nutrients, particularly potash, even on a soil of higher analysis. The better types of soils and those containing large amounts of plant-nutrient elements will endure exhaustive cropping much longer than the soils of low plant-nutrient content.

The nitrogen, phosphorus, and potassium contents of a soil are by no means the only chemical indications of high or low fertility. One of the most important factors in soil fertility is the degree of acidity. Many soils that are very strongly acid will not produce well, even though there be no apparent lack of plant-nutrient elements. Although nitrogen, phosphorus, and potassium are of some value when added to acid soils, they will not produce their full effect where calcium is deficient. Table 6 shows the percentage of nitrogen and the acidity and lime requirements of the various soils in Brown County.

The acidity is expressed as pH, or intensity of acidity. For example, pH 7 is neutral, and a soil with a pH value of 7 contains just enough lime to neutralize the acidity. If the pH value is more than 7, there is some lime in excess. From pH 6 to pH 7 indicates slight acidity, and from pH 5.6 to pH 6 shows medium acidity. If the pH value runs below 5.6 the soil is strongly acid. As a rule, the stronger the acidity the more a soil needs lime. Samples were taken from the surface soil (0 to 6 inches), from the subsurface soil, and from the subsoil. It is important to know the reaction, not only of the surface soil, but of the lower layers of the soil as well. Given two soils of the same acidity, the one with the greater acidity in the subsurface layer is in greater need of lime than the other. The slighter the depth of acid soil, the less likely it is to need lime. Those soils having the greater clay content will need a greater amount of lime to neutralize them, given the same degree of acidity. The less phosphorus, calcium, and magnesium the soil contains, the more likely it is to need lime. It is well to remember that sweetclover, alfalfa, and red clover need lime more than other crops do. As it is advisable to grow these better soil-improvement legumes in the rotation, it is in many places desirable to lime the land in order that sweetclover or alfalfa will grow.

In interpreting the soil survey map and soil analyses, it should be borne in mind that a well-farmed, well-drained, well-fertilized, well-manured soil that is naturally low in fertility may produce larger crops than a poorly farmed soil naturally higher in fertility.

TABLE 6.—*Nitrogen, acidity, and lime requirement of certain soils in Brown County, Ind.*

Soil type	Depth	Nitrogen	pH value	Average depth of acid soil	Indicated limestone requirement per acre
	Inches	*Percent*		*Inches*	*Tons*
Zanesville silt loam	0–6	0.10	5.3	(1)	2-4
	6–18	.05	4.8		
	18–36	.04	4.7		
Wellston silt loam	0–6	.10	5.8	(1)	2-4
	6–18	.04	5.0		
	18–36	.04	4.7		
Muskingum silt loam, colluvial phase	0–6	.09	5.5	(1)	2-4
	6–18	.06	5.2		
	18–36	.04	5.0		
Tilsit silt loam	0–6	.11	5.5	(1)	2-4
	6–18	.06	5.0		
	18–36	.04	4.5		
Parke silt loam	0–6	.11	5.3	120	2-4
	6–18	.05	5.1		
	18–36	.03	5.0		
Cincinnati silt loam	0–6	.11	5.3	108	2-4
	6–18	.06	5.1		
	18–36	.03	4.9		
Cincinnati silt loam, shallow phase	0–6	.10	5.1	(1)	2-4
	6–18	.05	5.0		
	18–36	.04	4.9		
Gibson silt loam	0–6	.10	5.6	108	2-4
	6–18	.05	5.2		
	18–36	.03	5.0		
Russell silt loam	0–6	.13	5.3	45	2-4
	6–18	.04	5.4		
	18–36	.03	5.4		
Otwell silt loam	0–6	.10	5.2	65	2-4
	6–18	.06	5.1		
	18–36	.05	4.9		
Haubstadt silt loam	0–6	.10	5.0	70	2-4
	6–18	.04	4.8		
	18–36	.02	4.5		
Pekin silt loam	0–6	.11	5.4	70	2-4
	6–18	.07	5.2		
	18–36	.03	5.0		
Fincastle silt loam	0–6	.12	6.0	40	1-2
	6–18	.07	5.7		
	18–36	.05	6.8		
Avonburg silt loam	0–6	.11	5.3	108	2-4
	6–18	.06	4.8		
	18–36	.04	4.9		
Clermont silt loam	0–6	.10	5.2	108	2-4
	6–18	.05	4.8		
	18–36	.02	4.8		
Bartle silt loam	0–6	.10	5.5	75	2-4
	6–18	.04	5.0		
	18–36	.02	4.8		
Peoga silt loam	0–6	.09	5.2	75	2-4
	6–18	.06	5.0		
	18–36	.04	4.8		
Pope silt loam	0–6	.10	5.6	70	2-4
	6–18	.07	5.5		
	18–36	.04	5.1		
Pope loam	0–6	.08	5.7	70	2-4
	6–18	.05	5.3		
	18–36	.04	5.0		
Pope flaggy loam	0–6	.13	5.3	70	2-4
	6–18	.08	5.5		
	18–36	.04	5.6		
Philo silt loam	0–6	.08	5.3	70	2-4
	6–18	.07	5.0		
	18–36	.06	4.6		
Philo loam	0–6	.06	5.2	70	2-4
	6–18	.05	5.1		
	18–36	.04	4.8		
Stendal silt loam	0–6	.09	5.0	70	2-4
	6–18	.06	4.9		
	18–36	.06	4.8		
Atkins silt loam	0–6	.10	5.1	70	2-4
	6–18	.06	5.0		
	18–36	.06	4.9		

[1] To bedrock.

SOIL MANAGEMENT

For convenience in discussing the management of the several soils of this county, they are arranged in groups according to certain important characteristics, which indicate that in many respects similar treatment is required. For example, several of the silt loams of the uplands and terraces, which have practically the same requirements for their improvement, may be conveniently discussed as a group, thus avoiding the repetition that would be necessary if each were discussed separately. Where different treatments are required they are specifically pointed out. About 86 percent of the soils of Brown County are rolling to broken and hilly silt loam and stony silt loam uplands and silt loam terraces of which approximately two-thirds are nonarable. About 1 percent of the total area of the county is occupied by poorly drained flat to gently undulating uplands and terraces, and about 13 percent consists of overflow bottom lands. The management of these groups of soils will be discussed separately. The reader should study the group including the soils in which he is particularly interested. There are no sandy soils in the county.

WELL-DRAINED SOILS OF THE UPLANDS AND TERRACES

The group of well-drained soils of the uplands and terraces comprises the Zanesville, Tilsit, Wellston, Muskingum, Cincinnati, Gibson, Parke, Russell, Otwell, Haubstadt, Elkinsville, and Pekin silt loams, the Muskingum stony silt loam, and the Wellston-Muskingum complex. Together, these soils occupy 177,920 acres, or 85.8 percent of the total area of the county. All of the Muskingum stony silt loam, which occupies 111,936 acres, or 54 percent of the total area of the county; the eroded, gullied, and slope phases of the Zanesville, Wellston, Cincinnati, and Otwell soils; some of the Elkinsville, and most of the Wellston-Muskingum complex are unfit for cultivation and are classed as nonarable land. A separate discussion of these will be found at the end of this section on soil management.

The arable soils of the group, although differing more or less in appearance owing to origin and topography, have certain important characteristics in respect to which their management problems are similar. All are low in total content of organic matter, nitrogen, and phosphorus; most of them are low in available potash; and all are acid and in need of liming.

Drainage.—The almost level and gently sloping areas of Tilsit silt loam on the broader ridge tops and the more level areas of the Haubstadt silt loam would be benefited by some tile underdrainage. The more rolling and hilly soils have fair to good internal drainage, but, owing to slow permeability and sloping topography, much of the rain water that falls on them is liable to runoff over the surface instead of being absorbed for the benefit of crops. This often results in serious erosion damage where the land is not protected against excessive runoff.

Control of erosion.—On most of the soils of this group, the problems of controlling erosion are of major importance in practical systems of soil management. Even after taking out of cultivation all the rough and very sloping land, which should never be plowed, the rest of the tillable land needs especial care in order to prevent further

destructive erosion. In many places the surface soil already has gone, and further sheet erosion and gullying are constantly making matters worse. The surface soil contains the greater part of the store of fertility and should be protected against erosion by every practical means. Gradual sheet erosion, whereby the runoff of rainwater moves the surface soil down the slope a little at a time and rather evenly, is the most insidious form of erosion and may not be noticed until the subsoil begins to appear. Many one-time fertile fields have been irreparably damaged in this way, and many others have only a little of the surface soil left and the plow reaches into the unproductive subsoil. Plowing and the other tillage operations should extend crosswise of the slopes wherever possible, in order to prevent the formation of watercourses down the slopes, which are sure to carry away much valuable surface soil and may start serious gullies. Contour plowing and contour strip cropping may be most practical on fields of irregular slopes, whereas terracing may be most practical on long even slopes. By rearranging fences or other field boundaries, it may be possible to arrange the cropping system in such way as to facilitate the performance of all tillage operations crosswise of the slopes. Intertilled crops should be interspersed with small-grain and sod-forming crops. Incipient gullies, or draws, forming natural waterways down the slopes, should be kept permanently in grass with a good sod of sufficient width to allow the water to spread and thereby prevent soil cutting.

Liming.—All the soils of this group are strongly acid, and liming should be a first step in any soil improvement program. A very acid soil will not respond properly to other needed treatments until it has been limed.

To determine the lime requirement, the soil should be tested for acidity. The test is simple and should not be neglected. If the farmer cannot make the test, he can have it made by the county agricultural agent or the vocational agriculture teacher, or he can send representative samples of the soil and subsoil to the Purdue University Agricultural Experiment Station at Lafayette. Ground limestone generally is the most economical form of lime to use. Comparative values should be calculated on the calcium carbonate equivalent. On the more acid soils the first application should be at least 2 tons to the acre. After that, 1 ton to the acre every second round of the crop rotation will keep the soil sufficiently sweet for most crops otherwise adapted to these soils.

Organic matter and nitrogen.—All the soils of this group are naturally low in organic matter and nitrogen. Constant cropping without adequate returns to the land and more or less soil erosion on sloping areas are steadily making matters worse. In many places the original supplies of organic matter have become so reduced that the soil has lost much of its natural mellowness, and it readily becomes puddled and baked. The only practical remedy for this condition is to plow under more organic matter than is used in the processes of cropping. Decomposition is constantly going on and is necessary to maintain the productivity of the soil. Decomposing organic matter must also supply the greater part of the nitrogen required by crops. For this reason, legumes should provide large amounts of the organic matter to be plowed under. On the strongly

acid soils, soybeans or cowpeas may be used to start with, because they will stand considerable soil acidity; but the land should be thoroughly limed and put into condition to grow clover and alfalfa as soon as possible. Liberal phosphate and potash fertilization will be necessary also, in order to produce satisfactory crops.

Clover or some other legume should appear in the rotation every 2 or 3 years; as much manure as possible should be made from the produce that can be utilized for livestock; and all produce not utilized, such as cornstalks, straw, and cover crops, should be plowed under. It must be remembered that legumes are the only crops that can add appreciable quantities of nitrogen to the soil, and then only in proportion to the amount of top growth that is returned to the land, either directly or in the form of manure. Wherever clover seed crops are harvested, the threshed haulm should be returned to the land and plowed under. Cornstalks, straw, or other crop residues should not be burned. Burning destroys both organic matter and nitrogen. Modern plows equipped with Purdue trash shields will turn down and completely cover cornstalks or other heavy growth. Cover crops should be grown wherever possible, to supply additional organic matter for plowing under. Planting soybeans, cowpeas, or sweetclover between the corn rows at the time of the last cultivation, and seeding rye as a cover crop early in fall on cornland that is to be plowed the following spring, are good practices for increasing the supply of both nitrogen and organic matter. It is important to have a growing crop of some kind on these soils during the winter, in order to take up the soluble nitrogen that otherwise would be lost through leaching. Without living crop roots to take up the nitrates from the soil water, large losses may occur between crop seasons through drainage. In this latitude the ground is not frozen much of the time during the winter, and frequent heavy rains cause much leaching and loss of plant nutrients, especially nitrates, if they are not taken up by crops.

Crop rotation.—With proper liming and fertilization, these soils will produce satisfactorily all the ordinary crops adapted to the locality. On account of the prevailing shortage of organic matter and nitrogen, every system of cropping should include clover or some other legume to be returned to the land in one form or another. Corn, wheat, and clover, or mixed clover and timothy, constitute the best short rotation for general use on these soils after liming, especially where the corn can be cut and the ground can be disked and properly prepared for wheat. The corn, wheat, and clover rotation can be readily lengthened to 4 or 5 years by seeding timothy, lespedeza, and alfalfa with the clover and allowing the stand to remain for 2 or 3 years to be used for either hay or pasture.

The 4-year rotation of corn, soybeans, wheat, and clover, or mixed clover, alfalfa, lespedeza and timothy, is well adapted to these soils if erosion can be controlled. In this rotation rye should be seeded in the cornfields as a winter cover crop and plowed under late in spring in preparation for the soybeans. The wheat should be seeded in the soybean stubble without plowing. The two legumes will build up the nitrogen supply of the soil. The soybean straw, or its equivalent in manure, should be spread on the wheat in winter. This will not only help the wheat and lessen winter injury but will also help to insure a stand of clover. Spring oats are not

well adapted to the climatic conditions of this section of the State and, as a rule, are not a profitable crop. Hardy varieties of winter oats and winter barley are being developed and may come into use more extensively on the better drained soils.

If more corn is wanted, as on livestock farms, the 5-year rotation of corn, corn, soybeans, wheat, and clover or mixed seeding may be used satisfactorily where the second corn crop, at least, can be given a good dressing of manure. Where enough livestock is kept to utilize all the grain and roughage in this rotation, enough manure should be produced to make a fair application for each corn crop. A cover crop of rye for plowing under the following spring should be seeded in September on all the cornland. Even though the land has been properly limed, clover may be uncertain on some of these soils, owing to climatic conditions, and it has proved to be a good plan to sow a mixture of seeds made up of about 3 pounds of red clover, 3 pounds of alfalfa, 2 pounds of alsike clover, 2 pounds of timothy, and 4 pounds of Korean lespedeza to the acre. Where the seeding fails to make a satisfactory stand, soybeans make a good substitute hay crop. Lespedeza may be used to advantage in pasture mixtures and on thin spots in old pastures that need improvement, especially where the pasture land is acid and liming is not feasible.

Alfalfa and sweetclover may be grown on most of the soils of this group if properly inoculated and sufficiently limed to meet the needs of these crops. Alfalfa is preferable for hay, and sweetclover is excellent for pasture and for soil-improvement purposes. Special literature on the cultural requirements of these crops may be obtained from the Purdue University Agricultural Experiment Station at Lafayette.

Fertilization.—The soils of this group are naturally low in phosphorus, and in most of them the available supplies of this element are so very low that the phosphorus required by crops should be wholly supplied in applications of manure and commercial fertilizer. The nitrogen supplies in these light-colored soils are also too low to meet satisfactorily the needs of corn, wheat, and other nonleguminous crops, and provisions for adding nitrogen should be an important part in the soil-improvement program. The total quantities of potassium in these soils are large, but the available supplies are low, and in most places the addition of some potash fertilizer would be profitable, especially where little manure is applied. Without substantial provision for supplying all three of these fertilizer elements, the productivity of these soils will remain relatively low.

The problem of supplying nitrogen has been discussed in connection with provisions for supplying organic matter. Legumes and manure are the logical and only really practical materials for supplying the greater part of the nitrogen needed by crops, and they should be employed for this purpose. A system of livestock farming, with plenty of legumes in the crop rotation, is best for these soils. It will pay on most farms, however, to have some nitrogen in the fertilizer for wheat, regardless of its place in the rotation. Even though wheat follows soybeans or other legumes, it should receive some fertilizer containing nitrogen at seeding time to start the crop properly, because the nitrogen in the residues of an immediately preceding legume does not become available quickly enough to be of much help to the wheat in the fall. The leguminous residue

must first decay, and that does not take place to any great extent until the following spring.

Phosphorus is the mineral plant nutrient in which these soils are most deficient. In all, the natural supply is small and should not be drawn on further. In areas where much of the surface soil has been washed away, the greater part of the phosphorus has gone with it. The only practical way to increase the supply of phosphorus in the soil is through the application of purchased phosphatic fertilizers, and it will prove profitable in most instances to supply the entire phosphorus needs of crops in this way. In rotations of ordinary crops, producing reasonable yields, it may be considered that 20 pounds of available phosphoric acid to the acre is required each year. It will pay well to apply larger quantities at first, so as to create a little reserve. In applying phosphate, enough for the entire rotation may be applied at one time, or the application may be divided, according to convenience. Where manure is applied, it may be counted that each ton supplies about 5 pounds of phosphoric acid; therefore, a correspondingly smaller quantity need be provided in the commercial fertilizer.

The quantity of potash that should be applied as fertilizer depends on the general condition of the soil and the quantity of manure used. According to the analyses in table 5, most of the soils of this group are low in available potash. If the weak-acid-soluble potassium is below 200 pounds an acre of plow depth, the chances are that it will pay to use some potash fertilizer. In building up a run-down soil, considerable quantities of fertilizer potash should be used, at least until such time as considerable quantities of manure can be applied, or until the general condition of the soil has materially improved. There is plenty of potassium in these soils for all time if it could be made available at a faster rate. As a rule it becomes available too slowly. The availability of the soil potash may be increased by good farm practices, including proper tillage, the growing of deep-rooted legumes, and the plowing under of liberal quantities of organic matter. The better these practices are carried out and the larger the quantity of manure applied, the less potash fertilizer need be purchased.

In the practical fertilization of these soils, most of the manure should be plowed under for the corn crop. When the crop rotation includes wheat, as should generally be the case, a part of the manure, about 2 tons to the acre, may be applied profitably on the wheatland as a top dressing during the winter. Manure so used not only helps the wheat and lessens winter injury but also helps to insure a stand of clover or other crop seeded in the wheat. Unless very heavily manured, corn should receive in addition about 100 pounds of 0–14–6 or 0–12–12 to the acre in the row or hill at planting time. Without manure, corn should be given from 150 to 200 pounds to the acre of a phosphate and potash mixture at least as good as 0–12–12, applied in the row or hill. Wheat should be given from 200 to 300 pounds to the acre of a high-analysis complete fertilizer at least as good as 2–12–6.

On the poorer soils, where large amounts of fertilizer are needed to build up productivity quickly, it may be most practicable to plow under extra amounts of fertilizer. Such deep application is especially advantageous in dry seasons, because it insures availability of

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the fertilizer to crop roots, while shallow applications may be lying in dry soil and temporarily unavailable. Such deep applications should supply a balanced ration of the nutrients required by the crop until such time as more of the nitrogen needed can be supplied through legumes.

In places where the wheat is backward in spring, a top dressing of about 100 pounds to the acre of a good soluble nitrogen fertilizer should be applied soon after growth begins. Such top dressing generally will add about 5 bushels an acre to the yield.

For special crops, special fertilization will be needed. Specific fertilizer recommendations for different crops on different soils under different conditions can be procured from the Agricultural Experiment Station at Lafayette.

POORLY DRAINED SOILS OF THE UPLANDS AND TERRACES

The group of poorly drained soils of the uplands and terraces comprises the silt loams of the Avonburg, Clermont, Fincastle, Bartle, and Peoga series. While not extensive in total area, these soils are nevertheless important in a county that has so little arable land, because, with proper attention to drainage, liming, and fertilizing, they are all tillable and may be made profitably productive.

The several soils of this group have some important characteristics in common, in respect to which their management problems are similar. They all need artificial drainage; all are low in total content of organic matter, nitrogen, and phosphorus; most of them are low in available potassium; and all are acid and need liming.

Drainage.—The soils of this group were all developed under conditions of poor drainage. Their generally flat topography and heavy subsoils make them naturally wet and more or less seriously in need of artificial drainage. Surface drainage by means of dead furrows and open ditches is wasteful of fertility in surface runoff and does not drain the subsoil for proper rooting of crops. Tile underdrainage should be installed as early as possible in any permanent improvement program. Without tile drainage, these soils cannot be managed to the best advantage, and no other beneficial soil treatment can produce its full effect.

With reasonable provision for drainage, these soils respond well to lime, legumes, manure, and fertilizer and can be made highly productive. This has been fully demonstrated on the soil fertility experiment fields conducted by the Purdue University Agricultural Experiment Station on Clermont and Avonburg silt loams and similar poorly drained soils in other parts of the State. The results of experiments on these fields indicate that tile lines laid 30 to 36 inches deep and not more than 3 rods apart will give satisfactory results.

Where the land is flat, great care must be exercised in tiling in order to obtain an even grade and uniform fall. Unsatisfactory results in tiling these flat lands are traceable to errors in grades, which allow silting up in low places, and to poor grades of tile, which chip and break down easily. Only the best grade of tile should be used. Grade lines should not be established by guess or by rule-of-thumb methods. Nothing less accurate than a surveyor's instrument should be used, and the lines should be accurately staked and graded

before the ditches are dug, to make sure that all the water will flow to the outlet with no interruption or slackening of the current. The grade, or rate of fall, should be not less than 3 inches to 100 feet. The rate of fall may be increased toward the outlet, but it should never be lessened without the introduction of a silt well, or settling box, as checking the current in the line may cause the tile to become choked with silt. Silt wells may be made of brick or concrete and should be at least a foot square inside. The bottom should be a foot lower than the bottom of the tile. The well should have a removable cover, in order that it may be opened once or twice a year for the purpose of dipping out the silt that has settled in the bottom. It is an excellent plan, before filling the ditches, to cover the tile to a depth of a few inches with a layer of straw, weeds, or grass. This prevents silt from washing into the tile at the joints while the ground is settling, thus insuring perfect operation of the drains from the beginning.

In a special tile drainage experiment on the Clermont silt loam of the Jennings County Experiment Field near North Vernon, the land tiled 3 rods apart in 1920 has since averaged 15.4 bushels more corn, 1.1 bushels more soybeans, 7.3 bushels more wheat, and 518 pounds more hay to the acre than the untiled land with the same lime and fertilizer treatment. The cost of tiling was paid for by the increased yields of crops during the first 8 years of the experiment, and since then the increased returns have averaged approximately $5 an acre a year.

Liming.—All the soils of this group are acid and more or less in need of lime. A very acid soil will not respond properly to other needed treatments until it has been limed. None of the soils of this group will produce a satisfactory crop of clover without liming. The amounts of ground limestone that should be applied to these soils is shown in the last column of table 6.

On the Jennings County Experiment Field near North Vernon, which is located on Clermont silt loam, land that received 3 tons of ground limestone to the acre in 1921 and 2 tons in 1935, in addition to being well fertilized, has averaged 16.3 bushels more corn, 4.8 bushels more wheat, and 1,395 pounds more hay to the acre than land similarly fertilized but not limed. In the 20-year period to the end of 1940, the total acre value of the crop increases due to liming has amounted to over $117. The total cost of liming is liberally estimated at $12.50 an acre. On the Scottsburg experiment field, located on Avonburg and Gibson silt loams, $10 spent for ground limestone from 1911 to 1931 returned over $48 in crop increases.

Organic matter and nitrogen.—The soils of this group are similar to the well-drained soils of the uplands and terraces in their organic-matter and nitrogen content, and what has been said in this regard concerning those soils applies equally well here. The cropping systems and the soil-management program should provide for the use of legumes, which supply both organic matter and nitrogen. Special green manuring crops and winter cover crops for plowing under in spring should be utilized wherever possible, and all unused crop residue should be plowed under. Manure, of course, should be used to the fullest possible extent in all cases.

Crop rotation.—With proper attention to drainage, liming, and fertilization, the soils of this group are best adapted to the grain and hay crops used in general farming, and the rotations suggested for the well-drained soils of the uplands and terraces may be used. Because soil erosion is not a problem on these flat soils, the 5-year rotation of corn, corn, soybeans, wheat, and mixed clovers and grass will be satisfactory. On the Clermont silt loam of the Jennings County Experiment Field this rotation has averaged 56 bushels of corn, 21 bushels of soybeans, 23 bushels of wheat, and 2,900 pounds of hay to the acre during the 20 years from 1921 to 1940.

Fertilization.—The discussion of the manure and fertilizer requirements of the well-drained soils of the uplands and terraces hold also for these light-colored poorly drained soils, except that the ratio of potash in the fertilizers used should be somewhat higher because the natural processes that make soil potash available are less active in poorly drained soils. Corn particularly will respond to liberal amounts of potash, and tests generally indicate either 0–12–12 or 0–10–20 unless unusually large amounts of manure are used. It is generally advisable for wheat, also, to use more potash than on well-drained soils, especially for the benefit of the hay crop following.

BOTTOM LANDS

The bottom or overflow lands in Brown County consist of the silt loams of the Pope, Philo, Stendal, and Atkins series; Pope silt loam, high-bottom phase; Pope loam; Pope flaggy loam; and Philo loam. Together, these bottom-land soils occupy 27,200 acres or 13.2 percent of the total area of the county. The Pope and Philo soils, except the Pope flaggy loam, are among the most productive soils of the county and contribute very substantially to total crop production.

The greatest difficulty in the management of these bottom lands is to prevent damage from flooding. The Stendal and Atkins soils also have internal drainage problems, due to their relatively low positions some distance back from the streams. Artificial drainage should be provided for these soils wherever suitable outlets can be procured. This has already been done in many cases.

The Pope and Philo soils have fair to good internal drainage and soon drain out after floods have subsided.

Prevention of flooding is practically impossible so far as the individual farmer is concerned.

Liming.—These bottom lands are all strongly acid and very much in need of liming. No other beneficial soil treatment can be fully effective without liming. From 2 to 4 tons of ground limestone to the acre should be applied to all tillable areas. After such thorough liming, a ton to the acre every 8 or 10 years will be sufficient to keep the soil reasonably sweet.

Organic matter and nitrogen.—What has been said about supplying organic matter and nitrogen to the light-colored soils of the uplands and terraces applies equally well to the light-colored soils of the bottom lands. On the lighter colored and poorer areas of these soils especially, considerable quantities of organic matter should be plowed under, either directly as green-manure crops or in the form of animal manure, and legumes should be grown frequently in

the rotation and largely returned to the land in one form or another, in order to increase the nitrogen content.

Where the land is periodically flooded, clover and other deep-rooted legumes, especially biennials and perennials, cannot be depended on; but certain shallow-rooted legumes, such as soybeans, cowpeas, and sometimes alsike clover and lespedeza, can be grown satisfactorily. These crops should be used largely for gathering nitrogen from the air, which they will do in large measure when the soil is properly inoculated. Here again it must be remembered that only the top growth plowed under, either directly or in the form of manure, can really increase the nitrogen content of the soil, on which grain crops must depend. Crops seeded in summer or early in fall for winter cover and to add organic matter and conserve plant food, such as sweetclover, rye, or a mixture of rye and winter vetch, should be used to the fullest possible extent in the cornfields that are to be plowed again the following spring. Cornstalks should not be burned but should be completely plowed under whenever this is practicable.

Crop rotation.—Where overflows cannot be prevented, the crop rotation must consist largely of annual spring-seeded crops and such grass-and-clover mixtures as will not be seriously injured by ordinary floods. As a rule, overflow bottoms are best adapted to corn, but soybeans and in some places wheat, with a mixture of timothy and alsike clover following for a year or two, are satisfactory crops for this land; and some sort of rotation is advisable to help maintain fertility. Doubtless soybeans will become more important as a rotation crop on these soils if proper inoculation is provided. Timothy and alsike mixed will do well on this land after it has been limed, and this crop may be allowed to stand for 2 or 3 years. In places where the land is too acid for alsike, lespedeza may be used. On some areas where floodwater does not stand more than a few days at a time and the soil is pervious enough to permit rapid lowering of the water table, alfalfa and red clover may be grown successfully after the land is properly limed. For late seeding in emergencies, early varieties of soybeans and Sudan grass, for either hay or seed, will prove useful.

Fertilization.—Practically all of the bottom lands of this county are low in nitrogen and phosphorus, and often the available supply of potash is also low. It should be recognized that in most cases the floodwater sediments coming to these bottom lands from the adjoining watersheds are not so rich as they were years ago. The rich surface soil has gone from much of the upland, and the present floods carry little except eroded subsoil material of low fertility.

Nitrogen should be supplied in applications of manure and by the growth of such legumes as will not be seriously damaged by floodwater. As a rule, commercial nitrogenous fertilizers will not pay on corn but may be used to advantage in the few places where wheat can be grown and as a top dressing on timothy meadows. For cornland, a phosphate-potash mixture, such as 0–14–6 or 0–12–12, should be drilled in the row or placed beside the hill at the rate of 100 to 150 pounds to the acre. In most cases soybeans also should be fertilized with a phosphate-potash mixture disked in before planting or plowed under. In places where wheat is grown, a 2–12–6 fertilizer should be used for this crop at seeding time at a rate ranging from 200 to

300 pounds to the acre. Where alfalfa can be grown it should be liberally fertilized with phosphate and potash.

NONARABLE LAND

The more sloping, eroded, and gullied phases of the Cincinnati, Zanesville, Wellston, and Otwell soils; all of the Muskingum stony silt loam; and most of the Wellston-Muskingum complex are not suited to ordinary farming purposes and should be regarded as nontillable and kept out of cultivation. Some of the land in this category that has been cleared may be put into permanent pasture by seeding to a mixture of bluegrass, redtop, and lespedeza; but much of it should be reforested and given protection from livestock as the most practical means of saving it from complete destruction by erosion. Where it seems feasible to establish pasture on acid soil areas of nontillable land, the chances of success may be greatly improved by applications of 2 to 4 tons of ground limestone and 300 to 400 pounds of superphosphate to the acre, either on top of present stands or before fresh seedings.

Many acres in this county have been damaged seriously by erosion, and such damage will become progressively worse unless decisive steps are taken to prevent it. Establishment of a good vegetative cover to hold the soil in place is essential. Contour furrows on hillsides and dams or other engineering devices in gullies should be employed wherever practicable, but undisturbed forest or other solid vegetative cover should be the ultimate aim.

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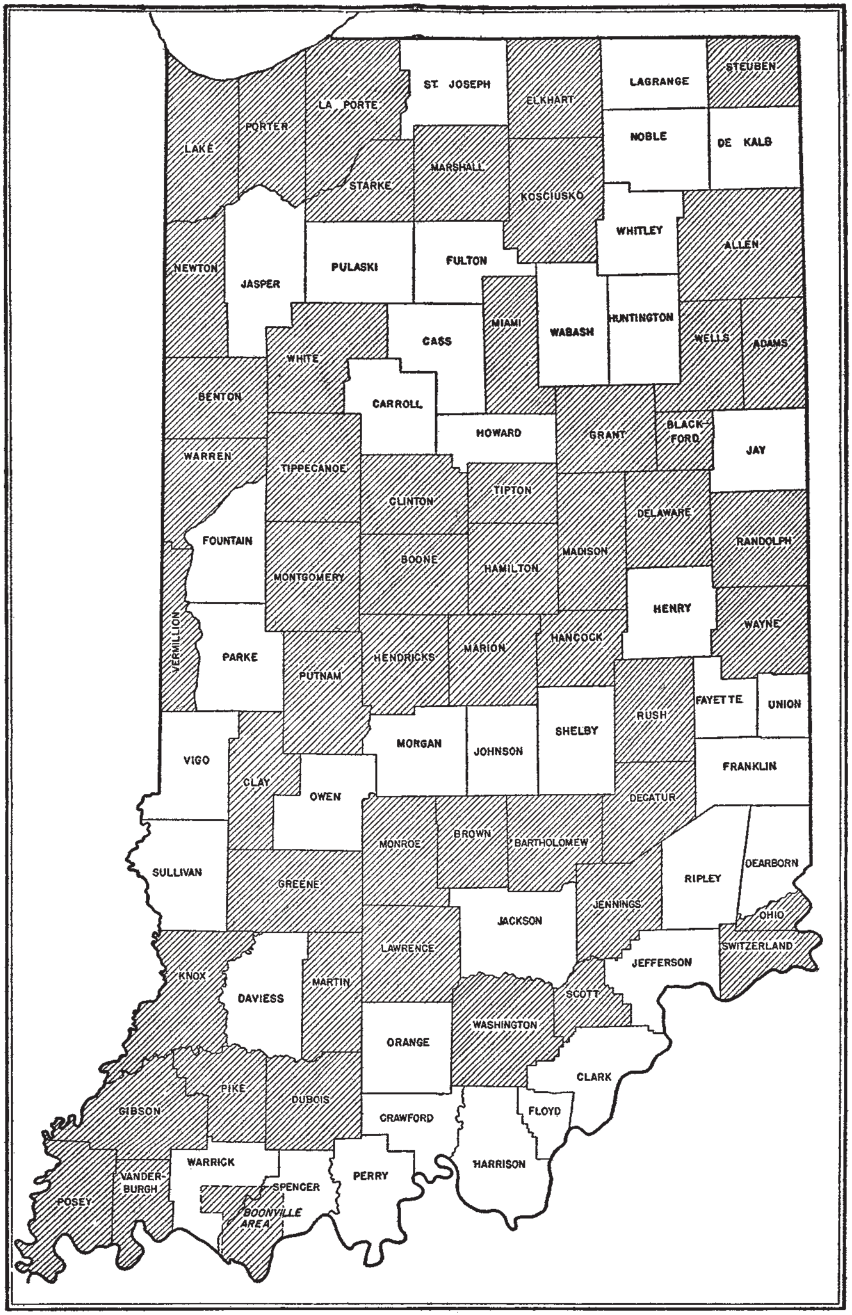

Areas surveyed in Indiana shown by shading.

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MAP DRAFTING, J. W. McKERICHER, IN CHARGE

SOIL MAP
BROWN COUNTY
INDIANA

PURDUE UNIVERSITY AGRICULTURAL EXPERIMENT STATION
J. H. SKINNER, DIRECTOR
A. T. WIANCKO, CHIEF, DEPARTMENT OF AGRONOMY
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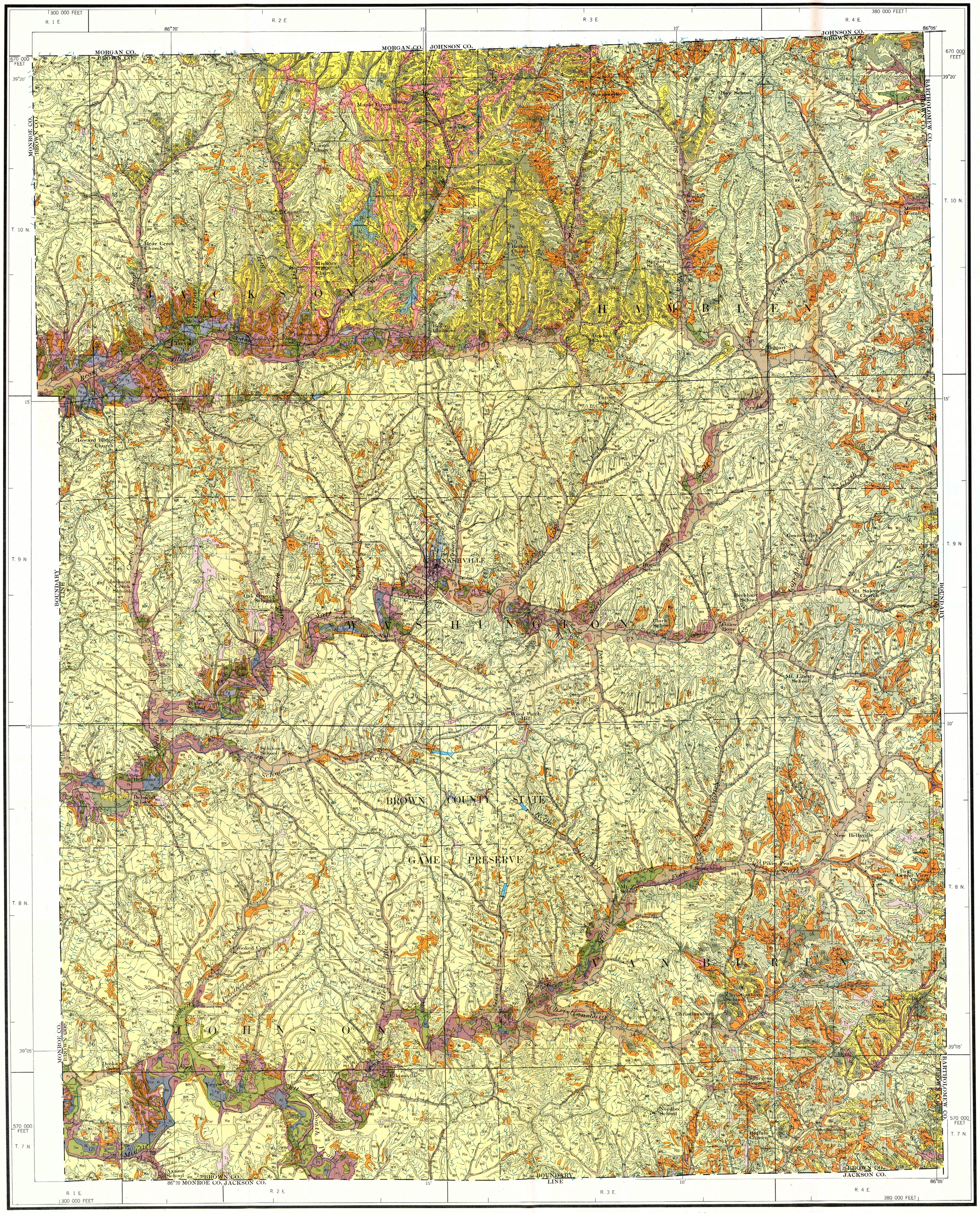

LEGEND

EXCESSIVELY DRAINED SOILS

STEEP SLOPES SANDSTONE AND SHALE UPLANDS
- Muskingum stony silt loam — Mm

MEDIUM TO STEEP SLOPES—ILLINOIAN GLACIAL TILL PLAIN
- Cincinnati silt loam
  - Clx — Slope phase
  - Clr — Eroded phase
  - Clg — Gullied phase
- Parke silt loam — Pk

WELL TO EXCESSIVELY DRAINED SOILS

MEDIUM TO STEEP SLOPES—SANDSTONE AND SHALE UPLANDS
- Muskingum silt loam, Colluvial phase — Mkt
- Wellston silt loam, Slope phase — Wsx
- Zanesville silt loam, Eroded phase — Zsr

MEDIUM TO STEEP SLOPES—LAKE TERRACES
- Otwell silt loam
  - Osx — Slope phase
  - Osr — Eroded phase

WELL-DRAINED SOILS

GENTLY TO MEDIUM SLOPING RIDGES SANDSTONE AND SHALE UPLANDS
- Wellston silt loam — Ws
- Wellston-Muskingum complex — WM
- Zanesville silt loam — Zs

GENTLE TO MEDIUM SLOPES STREAM AND LAKE TERRACES
- Elkinsville silt loam — Es
- Otwell silt loam — Os

GENTLE TO MEDIUM SLOPES ILLINOIAN GLACIAL TILL PLAIN
- Cincinnati silt loam — Cl
  - Clh — Shallow phase

GENTLE TO MEDIUM SLOPES EARLY WISCONSIN GLACIAL TILL PLAIN
- Russell silt loam — Rs

LEVEL-BOTTOMLANDS OR FLOOD PLAINS
- Pope flaggy loam — Po
- Pope loam — Pm
- Pope silt loam — Ps
  - Psb — High-bottom phase

MODERATELY WELL-DRAINED SOILS

SMOOTH RIDGE TOPS SANDSTONE AND SHALE UPLANDS
- Tilsit silt loam — Ts

UNDULATING UPLANDS ILLINOIAN GLACIAL TILL PLAIN
- Gibson silt loam — Gl

GENTLY UNDULATING STREAM AND LAKE TERRACES
- Haubstadt silt loam — Hs
- Pekin silt loam — Pt

LEVEL-BOTTOMLANDS OR FLOOD PLAINS
- Philo loam — Ph
- Philo silt loam — Pl

IMPERFECTLY DRAINED SOILS

NEARLY LEVEL UPLANDS ILLINOIAN GLACIAL TILL PLAIN
- Avonburg silt loam — As

NEARLY LEVEL STREAM TERRACES
- Bartle silt loam — Bs

NEARLY LEVEL UPLANDS EARLY WISCONSIN GLACIAL TILL PLAIN
- Fincastle silt loam — Fs

LEVEL BOTTOMLANDS OR FLOOD PLAINS
- Stendal silt loam — Sm

POORLY DRAINED SOILS

LEVEL UPLANDS ILLINOIAN GLACIAL TILL PLAIN
- Clermont silt loam — Cm

LEVEL STREAM TERRACES
- Peoga silt loam — Pg

LEVEL-BOTTOMLANDS OR FLOOD PLAINS
- Atkins silt loam — At

CONVENTIONAL SIGNS

CULTURE
(Printed in black)

City or Village, Roads, Buildings, Wharves, Jetties, Breakwater, Levee, Lighthouse, Fort
Secondary roads and Trails
Railroads Steam and Electric (DOUBLE TRACK, SINGLE TRACK, JUXTAPOSITION, IN ROAD)
Bridges, Ferry
R.R. crossings, Tunnel (R.R. ABOVE, R.R. BELOW)
Ford, Dam, Sawmill, Windmill
Boundary lines (STATE, COUNTY, CIVIL TOWNSHIP)
School, Church, Creamery, Cemeteries (CEM)
Boundary lines (RESERVATION, LAND GRANT, CITY OR VILLAGE)
Triangulation station, Boundary monument, Oil or Gas wells
U.S. Township and Section lines, Recovered corners

CULTURE
(Printed in black)

Forest fire station, Airway beacon, Oil or Gas tanks
Transmission line, Oil or Gas pipe line
Mine or Quarry, Rock outcrop, Made land
Soil boundaries, Stony, Gravelly and Cherty areas

DRAINAGE
(Printed in blue)

Streams, Springs, Wells, Flowing wells
Lakes, Ponds, Intermittent lakes
Unsurveyed and Intermittent streams
Water pipe lines, Canals, Ditches, Flumes
Swamp, Salt marshes
Submerged marsh, Tidal flats

The above signs are in current use on the soil maps. Variations from this usage appear in some maps of earlier dates.

Mark Baldwin, Inspector, District 1.
Soils surveyed by O. C. Rogers, in charge, and Ralph G. Leighty, U. S. Department of Agriculture, and H. P. Ulrich and Sutton Myers, Purdue University Agricultural Experiment Station.

1 ½ 0 1 2 3 4 Miles
Scale 1 inch-1 mile

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Polyconic projection, 1927 North American datum.
Horizontal control by U. S. C. and G. S.
Base map compiled by Department of Agronomy, Purdue University, from aerial photographs.
10,000 foot grid based upon Indiana (East) system of plane coordinates.
Surveyed in 1935-36. Series 1936.